Volume 22, Number 15, August 15, 1968

NUCLEAR SCIENCE ABSTRACTS

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Index References

All index entries refer the reader to volume and abstract number:

FOURRIER, Alain
Radioactive chain of mass number 189, 21:10023

Personal Authors

Every author's name is indexed in the form appearing on the document abstracted:

MONTH, M.
Theory of gradient perturbations in AGS, 21:9872 (BNL-10899)
MONTH, Melvin
Simple relativistic calculation of the electromagnetic form factors of the deuteron, 21:9744

Subjects

The subject index consisting of specific materials, objects, and processes is arranged alphabetically. Modifying phrases specific to these subjects in turn are arranged alphabetically under the subjects.

SHEEP
radiation dosimetry in, measurement of lethal dose of x, 21:8905(R) (AD-631189)
radiosensitivity of hematopoietic system of, x, 21:8905(R) (AD-631189)

SHELTERS
construction of, for civil defense, 21:8838
design of fallout, 21:8777(R) (AD-629736)
design of shaft closure for, 21:8563(P)
determination of configuration of, for ventilation, 21:8779(R) (AD-629928)
equipment for fallout, minimal requirements of, 21:8782(R) (AD-631424)
evaluation of fallout, for fire and air blast damage, 21:8560 (URS-658-3)
fire resistance of components of, evaluation of, 21:8789(R) (AD-642241)

Corporate Authors

Technical report literature is indexed from the name of the organization or institution responsible for the issuance of the report.

8500 (Y-1561) MIXING AND SAMPLING ENRICHED ^{235}U FLUIDS IN CYLINDRICAL STORAGE CONTAINERS. Final Report. Harrell, J. E. **(Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant).** Jan. 17, 1967. Contract W-7405-eng-26. 124p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

is indexed as:

UNION CARBIDE CORP., OAK RIDGE, TENN. Y-12 PLANT.
Mixing and sampling enriched ^{235}U fluids in cylindrical storage containers, 21:8500 (Y-1561)

Report Numbers

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TID-		
3311(Suppl. 2)	21-8567	Dep. mn. CFSTI $3.00 cy, $0.65 mn
22298	21-9915	Nucl. News, 9: No. 12, 17-21 (Dec. 1966)
22298	21-9914	Nucl. News, 10: No. 1, 17-20(Jan. 1967)
23267	21-9702	Phys. Rev., 152: 1171-82(Dec. 23, 1966)
23267	21-8498	Dep. mn. CFSTI $3.00 cy, $0.65 mn
23420	21-8764	Lancet, 2: 672-5(Sept. 24, 1966)
23474	21-8528	Dep. mn. CFSTI $3.00 cy, $0.65 mn
23478	21-8641	Dep. mn. CFSTI $3.00 cy, $0.65 mn
23482	21-9471	Dep. mn. CFSTI $3.00 cy, $0.65 mn

TABLE OF CONTENTS

Volume 22, Number 15, August 15, 1968

Category *Page*

- CHEMISTRY 3127
  - Analytical Chemistry 3127
  - Inorganic, Organic, and Physical Chemistry 3133
  - Radiation and Nuclear Chemistry 3140
  - Radiochemistry 3147
  - Separation Processes 3147
- EARTH SCIENCES 3152
  - Geology and Hydrology 3152
  - Meteorology 3154
  - Mineralogy and Exploration 3155
  - Oceanography 3155
  - Seismology 3155
- ENGINEERING 3156
  - Nuclear Explosions 3156
  - Facilities and Equipment 3156
  - Heat Transfer and Fluid Flow 3158
  - Isotope Technology 3158
  - Materials Testing 3160
  - Radioactive Material Handling 3162
  - Vacuum Engineering 3162
- INSTRUMENTATION 3164
  - Radiation Detection Instruments 3164
    - *General Detectors and Monitors* 3164
    - *Nuclear Spectroscopic Instrumentation* 3165
    - *High Energy Physics Instrumentation* 3166
  - Radiation Dosimeters 3167
  - Radiometric Instruments 3168
  - Miscellaneous Instruments and Components 3169
  - Radiation Effects on Instruments and Instrument Components 3172
- LIFE SCIENCES 3173
  - Biochemistry, Physiology, and Molecular Biology 3173
  - Ecology 3183
  - Genetics and Cytogenetics 3184
  - Health Physics and Safety 3189
  - Medicine 3194
  - Radiation Effects on Animals 3204
  - Radiation Effects on Plants 3214
  - Radiation Effects on Microorganisms 3216
  - Radiosterilization and Radiopreservation 3217
- METALS, CERAMICS, AND OTHER MATERIALS 3219
  - Metals and Alloys 3219
    - *Corrosion and Erosion* 3219
    - *Preparation and Fabrication* 3220
    - *Properties Evaluations* 3221
    - *Structure and Phase Studies* 3224
    - *Radiation Effects* 3228
  - Ceramics and Cermets 3230
    - *Preparation and Fabrication* 3230
    - *Properties Evaluations* 3232
    - *Structure and Phase Studies* 3235
    - *Radiation Effects* 3240
  - Plastics and Other Materials 3240
- PHYSICS (GENERAL) 3241
  - Astrophysics and Cosmology 3241
  - Atomic and Molecular Physics 3246
  - Cosmic Radiation 3252
  - Direct Energy Conversion 3253
  - Fluid Physics 3254
  - Geophysics 3255
  - Low-Temperature Physics 3259

Category *Page*

- PHYSICS (GENERAL) *cont'd.*
  - Plasma and Thermonuclear Physics 3264
    - *Confinement and Heating of Plasma* 3264
    - *Diagnostics of Plasma* 3265
    - *Kinetics of Plasma* 3265
    - *Production of Plasma* 3272
    - *Stability of Plasma* 3272
    - *Thermonuclear Processes* 3273
  - Shielding 3274
  - Solid-State Physics 3275
  - Theoretical Physics 3286
- PHYSICS (HIGH ENERGY) 3289
  - Particle Interactions and Properties (Experimental) 3289
    - *Electromagnetic* 3289
    - *Weak* 3289
    - *Strong (Baryon-Induced)* 3289
    - *Strong (Meson-Induced)* 3290
  - Particle Interactions and Properties (Theoretical) 3291
    - *General* 3292
    - *Electromagnetic* 3292
    - *Weak* 3293
    - *Strong (General)* 3295
    - *Strong (Baryon No. = 0)* 3295
    - *Strong (Baryon No. = 1)* 3296
    - *Strong (Baryon No. ≥ 2)* 3299
  - Particle Invariance Principles and Symmetries 3299
    - *General* 3299
    - *Applications (Electromagnetic and Weak)* 3300
    - *Applications (Strong)* 3300
  - Field Theories 3301
    - *General* 3301
    - *Quantum Field Theory* 3301
    - *Gravitation and General Relativity* 3302
  - Scattering Theory 3302
  - Particle Accelerators 3304
- PHYSICS (NUCLEAR) 3323
  - Neutron Interactions with Matter 3323
  - Nuclear Properties and Reactions, $A \leq 5$ 3327
  - Nuclear Properties and Reactions, $6 \leq A \leq 19$ 3327
  - Nuclear Properties and Reactions, $20 \leq A \leq 89$ 3329
  - Nuclear Properties and Reactions, $A \geq 90$ 3334
  - Nuclear Theory 3343
- REACTOR TECHNOLOGY 3350
  - Central Power Reactors 3350
  - Marine and Portable Power Reactors 3362
  - Rocket and Space Reactors 3364
  - Process Heat and Desalination Reactors 3366
  - Research and Test Reactors and Critical Assemblies 3366
  - Production Reactors 3374
  - Reactor Theory, Components, Fuels, and Accessories 3374
- GENERAL 3381
- CORPORATE AUTHOR INDEX INDEX-1
- PERSONAL AUTHOR INDEX INDEX-10
- SUBJECT INDEX INDEX-88
- REPORT NUMBER INDEX INDEX-209
- JOURNAL LIST APPENDIX-1

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Volume 22, Number 15 August 15, 1968

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical Chemistry

Refer also to abstracts 30572, 30693, 30709, 30836, 30850, 30881, 30883, 30896, 30903, 31007, and 31056.

30425 (AAEC/TM-421) THE DETERMINATION OF ^{90}Sr IN ENVIRONMENTAL AND BIOLOGICAL MATERIALS USING DI-(2-ETHYLHEXYL) PHOSPHORIC ACID. Flynn, W. W. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Dec. 1967. 18p. Dep.

A method is described in which strontium-90 is determined by solvent extraction of the yttrium-90 daughter. After a preliminary extraction of a hydrochloric acid solution of the sample by bis(2-ethylhexyl) phosphate, yttrium-90 is allowed to return to equilibrium in the presence of yttrium carrier. A second extraction quantitatively separates the yttrium-90 which is subsequently stripped into concentrated hydrochloric acid. An extraction with Aliquat 336 is used to remove interfering radionuclides before the yttrium is finally precipitated and counted as the oxalate. Typical recovery is 85 to 90 per cent. (auth)

30426 (AAEC/TM-454) TABLES OF MASS ABSORPTION COEFFICIENTS FOR USE IN X-RAY SPECTROCHEMICAL ANALYSIS. Champion, K. P.; Hurst, H. J.; Whittem, R. N. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Apr. 1968. 98p. Dep.

Leroux's data were used to construct a table of mass absorption coefficients (μ/ρ) for each element at a selection of wavelengths. Three sets of tables are presented, depending on the choice of wavelength intervals: arranged by K_α wavelengths, arranged by L_α wavelengths, and arranged by incremental wavelengths. (M.C.G.)

30427 (BNL-50083, pp 192-202) PROTON MICROANALYSIS. Sabine, T. M.; Bird, J. R. (Australian Atomic Energy Commission Research Establishment, Lucas Heights); Mak, B. K. (New South Wales Univ., Kensington (Australia). School of Physics).

Results of experiments in which a proton beam from a 3-MeV Van de Graaff accelerator was used to determine oxygen and nitrogen in Ti and carbon in steel are presented. The reactions used were, respectively, $^{18}O(p,\alpha)^{15}N$, $^{15}N(p,\alpha\gamma)^{12}C$, and $^{12}C(p,\gamma)^{13}N$. The method is complementary to the electron microprobe method in determining small-scale homogeneity of alloys; it is particularly useful for elements of low atomic number. (A.G.W.)

30428 (BNWL-SA-1790) DETERMINATION OF MICROGRAM QUANTITIES OF FLUORIDE IN METAL OXIDES. Plucinski, C. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 27, 1968. Contract AT(45-1)-1830. 6p. (CONF-680608-2). Dep. CFSTI.

From American Chemical Society Meeting, Portland, Ore.

Use of a fluoride-sensitive electrode for fluoride measurements in oxides is discussed. The calculated relative standard deviation of 16 results from measurements on U_3O_8 is 3%. (M.C.G.)

30429 (IS-1829) BIBLIOGRAPHY OF MASS SPECTROSCOPY LITERATURE FOR THE FIRST HALF OF 1967 COMPILED BY A COMPUTER METHOD. Capellen, J.; Svec, H. J.; Jordan, J. R.; Watkins, W. J. (Ames Lab., Iowa). Apr. 1968. Contract W-7405-eng-82. 350p. Dep. CFSTI.

The 3569 references given cover the first half of 1967. The report consists of three sections: a bibliography section, an author index section, and a key word out of context index (KWOC Index) section. The bibliography section lists the authors, the title, and the source citation for each article. The author index lists the authors' names and the reference numbers of their articles. The KWOC Index lists the key words, the reference numbers of the articles in which the key word appears, and the first 100 characters of their titles. (auth)

30430 (JEN-191-DQ/1-65) NUEVAS APORTACIONES A LA DETERMINACION ESPECTROGRAFICA DE IMPUREZAS EN MATERIALES DE URANIO POR EL METODO DE DESTILACION FRACCIONADA CON PORTADOR. (Current Contributions to the Spectrographic Determination of Impurities in Uranium Materials by the Method of Fractional Distillation With Carrier). Capdevila, C. (Junta de Energia Nuclear, Madrid (Spain)). 1967. 17p. (In Spanish). Dep.

The carrier distillation method for the determination of impurities in uranium has been modified in order to get a greater sensitivity. Electrodes 9.5 mm dia with a crater 7 mm dia and 10 mm deep have been used, with the weight of changer being 300 mg. The elements considered were: Al, As, B, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, P, Pb, Si, Sn, Ti, and V, over the range 0.01 to 30 ppM. Among the different carriers tested AgCl and the mixtures (3: 1) AgCl-AgF and (4: 3) AgCl-Ga_2O_3 have been chosen. The following experimental variables have been studied: the concentration of carriers, the arc current, the size of the vent forming tool, and the volatilization rates of every element. Palladium, indium, and silver have been tested as internal standards. A standard deviation from ±9.5% to ±18.5% is reported. (auth)

30431 (JEN-192-DQ/1-66) DETERMINACION ESPECTROGRAFICA DE IMPUREZAS EN TETRAFLUORURO DE URANIO. (Spectrographic Determination of Impurities in Uranium Tetrafluoride). Capdevila, C.; Roca Adell, M.; Alvarez, F. (Junta de Energia Nuclear, Madrid (Spain)). 1967. 11p. (In Spanish). Dep.

A carrier distillation method for the determination of Ag, Al, As, B, Cd, Cr, Cu, Fe, Mg, Mn, Ni, Pb, and Si in uranium tetrafluoride was developed. The previous addition of 25% Y_2O_3 prevents the excitation of uranium by conversion of the volatile UF_4 into U_3O_8 during the arc discharge. NaCl or Ga_2O_3, containing Ge and V as internal standards, are used as carriers, and samples are arced in 10 A dc arc in a graphite anode cup 7 mm diameter and 10 mm deep. Sensitivities are in the range 0.1 to 20 ppM and the precision attained lies between ±9.0 and ±16.4%. For Ca and P samples are mixed with SiO_2 and converted into the black oxide by heating at 400°C. (auth)

30432 (MG/D-201/62) ANALYSIS OF HIGHLY ALLOYED STEELS BY X-RAY FLUORESCENCE SPECTROMETRY. Sermin, D. F. (British Iron and Steel Research Association, London (England). Metallurgy Div.). [nd]. 19p. Dep. CFSTI. UK.

Experiments were carried out in order to assess the potentialities of x-ray spectrometry for the analysis of highly alloyed steels. A study was made of the effects of possible instrumental errors that may affect the analytical accuracy. Methods of effectively reducing these were considered. It was concluded that x-ray fluorescence spectrometry is both a rapid and accurate method for the analysis of highly alloyed steels for the elements Cr, Mn, Ni, Mo, Ti, and Nb. Inter-element effects were found to be of a very systematic and predictable nature. (P.C.H.)

30433 (NIM-177) COMPENSATING FOR FLUX VARIATION IN NEUTRON ACTIVATION ANALYSIS. Lowe, K.; Faure, P. K.;

Steele, T. W. (National Inst. for Metallurgy, Johannesburg (South Africa)). July 3, 1967. 31p. Dep.

The design and construction of equipment that will automatically compensate for flux changes during the neutron irradiation of samples are described. A circuit that is an electrical analog of the physical phenomenon was constructed, and was used to indicate electrically the exact amount of activity in the sample at any time. A switching circuit that starts the counting when the activity of the irradiated sample has decayed to a predetermined level is incorporated. Preliminary tests indicate that use of the circuit improves the statistics of the results. The circuit can easily be used with any existing neutron generator and ratemeter. (auth)

30434 (ORNL-tr-1925) PHOTONEUTRON METHOD OF ISOTOPIC ANALYSIS OF HYDROGEN IN NATURAL WATERS. Khristianov, V. K.; Vernadskii, V. I. Translated by Martha Gerrard (Oak Ridge National Lab., Tenn.), from Isotopenpraxis, 3: 235-7(1967). 6p. Dep. CFSTI. JCL $1.10 fs, $0.80 mf.

This paper was abstracted previously from the original language and appeared as NSA 21: 38886.

30435 (RFP-1122) ANALYTICAL INVESTIGATION OF PLUTONIUM OXIDE. Oetting, Franklin L.; Ferris, Yovonne M. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). May 10, 1968. Contract AT(29-1)-1106. 5p. Dep. CFSTI.

An analysis of plutonium in 36 samples of scrap plutonium oxide, each weighing approximately one kilogram, has been performed. Each sample was investigated by four separate analyses. Wet chemical analyses were performed on three of the samples taken from different locations within the container of plutonium material. The fourth analysis was a calorimetric technique which nondestructively analyzed the complete contents of the container. The results of all analyses were compared. (auth)

30436 (UCRL-50006-68-1) ANALYTICAL CHEMISTRY SECTION PROGRESS REPORT, JANUARY 1–DECEMBER 31, 1967. Harrar, J. E. (comp. and ed.) (California Univ., Livermore. Lawrence Radiation Lab.). Apr. 5, 1968. 49p. Dep. CFSTI.

Topics covered include: automation of the CEC mass spectrometer; computer control for simultaneous determination of C, H, and N in organic compounds; computer-controlled gas chromatograph; gas chromatograph for high-explosive compatibility testing; computer program for light-isotope mass spectrometry; coincident-field cycloidal-focusing mass spectrometer; field operational gas analytical facility; powder densitometer; gas pressures in chimneys created by underground nuclear explosions; microwave spectroscopic analyses of deuterium in water; gaseous dipole moment of methyl cyanoacetylene; computer system for chemical laboratory experimentation; on-line computer processing of spectrophotometric measurements; application of an on-line computer in rapid-scan polarography; electron microprobe; x-ray fluorescence; atomic absorption determination of silicon in alloys; spectroscopy of actinides; spectrographic observations of solar eclipse; spectrographic determinations of Hf in W; spectrographic determination of impurities in Re; determination of metallic impurities in W, Mo, and the alloy W–Mo–Re; determination of Re, W, and Mo in Re–W–Mo alloys; determination of fluoride in Mo, Re, and W; determination of fluoride with thorium nitrate; infrared determination of poly(2,2-dinitropropyl acrylate) in LX-09; determination of halogens in plastic-bonded explosives, plastics, and other organic compounds; determination of trace chlorine in fluoroelastomers; determination of Si, Fe, and halogens in boron silastics; determination of thorium in ThO_2–W mixtures; determination of C in Re; continuous determination of gold in solution; spectrophotofluorimetry; and controlled-potential coulometric determination of silver. (M.C.G.)

30437 RAPID AND SIMPLE CONTINUOUS RADIOCHEMICAL SEPARATION OF COPPER, MAGNESIUM, ZINC, AND MANGANESE IN BIOLOGICAL MATERIALS. Hahn, Kwang J.; Tuma, Dean J.; Sullivan, John L. (Veterans Administration Hospital, Omaha). Trans. Amer. Nucl. Soc., 11: 70-1(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30438 ANALITICHESKAYA KHIMIYA BERILLIYA. (Analytical Chemistry of Beryllium). Novoselova, Aleksandra Vasil'evna; Batsanova, Lyudmila Rafailovna. Moscow, Izdatel'stvo Nauka, 1966. 221p.

General information about the properties of the element and its compounds are presented, and chemical reactions that form the basis of the analysis are described. Physical, physicochemical, and chemical methods for the quantitative determination of Be in raw materials, typical intermediates, and finished products such as metals, alloys, oxides, salts, and other compounds and materials are presented. Rapid methods of analysis and the sensitivity and accuracy of the methods for determining traces of impurities are stressed. (ATD)

30439 ANALYSIS OF SODIUM BY SPARK SOURCE MASS SPECTROSCOPY. Berkey, E.; Sweeney, G. G.; Hickam, W. M. (Westinghouse Research Labs., Pittsburgh). Trans. Amer. Nucl. Soc., 11: 113(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30440 SPECTROCHEMICAL DETERMINATION OF MICROQUANTITIES OF THE RARE EARTH ELEMENTS IN COMPOUNDS OF NUCLEAR PURE URANIUM. Cheng, Po. Yuan Tzu Neng, No. 2, 97-108(1965). (In Chinese).

The separation, concentration, and determination of microquantities of Sm, Eu, Dy, and Er in compounds of pure nuclear U are studied. Separation is performed by the extraction method using a TBP solution in CCl_4. Extraction is 94% (with precipitation of the rare earth elements in the form of hydroxides, ~95% is extracted). Optimum conditions for spectral determination of the rare earth elements are found. Determination is not hindered by 125 μg Na, 100 μg Pb, 10 μg Al, Fe, and Mg. The interfering effect of ≤ 10 μg Ca and Th is eliminated through precipitation with NH_4OH in the presence of sulfosalicylic acid. The sensitivity of the method is: 0.05 μg Sm, 0.005 μg Eu, 0.16 μg Dy, and 0.06 μg Er. With minimal determined rare earth element concentrations, error constituted 11, 10, 12, and 14% respectively. (CFSTI)

30441 SENSITIVITIES IN ATOMIC-ABSORPTION SPECTROPHOTOMETRY. IV. Ramirez-Munoz, J.; Roth, M. E. (Beckman Instruments, Inc., Fullerton, Calif.). Flame Notes, Beckman, 2: No. 1, 18-23(1967).

Results are presented for Al, B, Ba, Be, Bi, Ca, Ce, Cr, Eu, Fe, Ge, K, La, Mg, Mo, Nb, Nd, Re, Sc, Si, Sn, Sr, Ta, Th, Ti, U, V, W, and Zr with a nitrous oxide–acetylene laminar-flow burner and a Beckman 979 spectrophotometer. A triple-pass system is not recommended for La, Sc, Th and U, but it is for Ca, Ce, Eu, Fe, Nd (at 468.4 nm), Nb, and W. A noticeable improvement in sensitivity is obtained for Ce and Th. All results are obtained under ideal aq. soln. conditions. (For Part III see Analyt. Abstr., 1968, 15: 679.) (Anal. Abstr.)

30442 PRELIMINARY INFORMATION SHEETS: ATOMIC-ABSORPTION FLAME PHOTOMETRY. Dagnall, R. M. (Beckman Instruments, Inc., Fullerton, Calif.). Flame Notes, Beckman, 2: No. 1, 24-7(1967).

Optimum operating conditions and sensitivity limits with use of three instruments are given for Ba, Be, B, and Eu. The most sensitive lines for measurement are those at 553.6, 234.9, 249.7, and 459.4 nm, respectively. (Anal. Abstr.)

30443 YTTRIUM AND RARE EARTH ELEMENTS IN SEA WATER. Shigematsu, Tsunenobu (Kyoto Univ.). Nippon Kaisui Gakkaishi, 21: 241-5(Mar. 1968). (In Japanese).

A study was made on the adsorption behavior of yttrium and rare earth elements in sea water. These elements adsorbed themselves to glass or polyethylene and to suspended particles from the solution of pH 5 to 8. Sample water, therefore, should be kept acidic (pH < 3) after sampling. As a result of fluorometric determination, sea water was found to contain about ~0.15 μg/l of yttrium, with over half of the content in suspended matter. Lanthanum and europium were determined by neutron activation, and the results were ~0.04 μg La/l and ~0.002 μg Eu/l. (NSA of Japan)

30444 METHOD AND APPARATUS FOR NONDESTRUCTIVE DETERMINATION OF ^{235}U IN URANIUM. Russell, James T. (to United States Atomic Energy Commission). U. S. Patent 3,389,254. June 18, 1968.

A method and device for determining the relative concentration of ^{235}U and ^{238}U in a sample of U are described. Detected γ rays, having an energy closely adjacent to but higher than the characteristic ^{235}U peak on the continuum of energies due to radioactive daughters of ^{238}U, are accumulated until a predetermined number is reached. During the time required to accumulate this predetermined number, the number of detected γ rays having an energy equal to the characteristic 185-keV ^{235}U peak are accumulated. The ratio of the two accumulated numbers is proportional to the relative concentration of ^{235}U and ^{238}U. (AEC)

30445 METHOD FOR DETERMINING THE AMOUNT OF ^{137}Cs IN IRRADIATED NUCLEAR FUEL. Haller, William A.; Perkins, Richard W.; Nielsen, Julian M. (to United States Atomic Energy Commission). U. S. Patent 3,388,254. June 11, 1968.

A method is described for determining the burnup of irradiated nuclear reactor fuel by eliminating γ radiation coincident with β emission due to ^{137}Cs and counting only the noncoincident γ radiation due to ^{137m}Ba, from which burnup may then be calculated. (AEC)

30446 NEUTRON ACTIVATION TYPING OF SEIZURE HEROIN CAPSULES. Rayudu, G. V. S.; Tiefenbach, B.; Jervis, R. E. (Univ. of Toronto). Trans. Amer. Nucl. Soc., 11: 81-2(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30447 NEUTRON-NEUTRON METHOD WITH RESONANCE NEUTRONS (NNM r). Vakhtin, B. S.; Novoselov, A. V.; Filippov, E. M. Geol. Geofiz., No. 2, 113-16(1967). (In Russian).

A version of the neutron-neutron method is described, which is based on the use of resonance cross sections in a number of elements (Ag, Mn, Re, In, Sm, Eu, Au, and others). The determination of the content of some of these elements in rocks, ores, and ore concentrates by present nuclear methods (such as activation) is faced with a whole series of difficulties: use of the resonance properties of the nuclei with respect to the neutrons in some cases permits determination of the content of a whole series of elements. The method can be used in the field as well as in the laboratory. The accuracy and sensitivity depend on the details of construction of the apparatus, thickness of the layer of the sample, and intensity of the neutron sources. (Geophys. Abstr.)

30448 THE CURRENT STATUS OF FORENSIC ACTIVATION ANALYSIS. Guinn, Vincent P. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc., 11: 78-9(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30449 ACTIVATION ANALYSIS INVESTIGATIONS ON BERNESE COINS OF THE 15TH AND 16TH CENTURIES. Wyttenbach, Armin. Schweiz. Muenzbl., 17: 15-24(1967). (In German). (EIR-116).

Activation analysis was carried out on some Bernese coins, the Plappart, minted in 1421 and 1490, the Funfer of 1466 and 1492, and the Rollbatzen of 1492 and 1528. The coins were exposed to neutron irradiation in the SAPHIR reactor. The gold content of these coins were determined and tabulated. The low silver content of the Rollbatzen is attributed to a better refining technique for the gold. The silver content of the coins was determined and compared. (J.S.R.)

30450 PHOTONUCLEAR ACTIVATION ANALYSIS FOR STRONTIUM WITH A ^{60}Co SOURCE. Veal, D. J.; Armstrong, F. E. (Bureau of Mines, Bartlesville, Okla.). Trans. Amer. Nucl. Soc., 11: 95-6(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30451 CASE APPLICATIONS OF FORENSIC ACTIVATION ANALYSIS IN CANADA. Krishnan, S. S.; Perkons, A. K.; Erickson, N. E. (Centre of Forensic Sciences, Toronto). Trans. Amer. Nucl. Soc., 11: 79(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30452 FORENSIC ACTIVATION ANALYSIS: BULLET LEAD. Lukens, H. R. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc., 11: 80-1(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30453 APPLICATIONS OF RARE-EARTH TRACERS TO GUNPOWDER RESIDUES. Pillay, K. K. S. (Western New York Nuclear Research Center, Inc., Buffalo); Thomas, C. C. Jr.; Sondel, J. A.; Thomas, R. C.; Didising, D.; Hart, D. M. Trans. Amer. Nucl. Soc., 11: 79-80(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30454 METHOD AND APPARATUS FOR ASSAYING THE LITHIUM ISOTOPE OF MASS NO. 6. Bruno, Georges; Decharge, Jacques; Perrin, Andre; Surget, Georges (to Commissariat a l'Energie Atomique). British Patent 1,112,815. May 8, 1968. Priority date Jan. 24, 1966, France.

A method for the determination of ^{6}Li comprises bombarding the sample with a beam of deuterons and detecting the α particles that are emitted simultaneously by the sample in two directions having an angular correlation relative to the beam such that they correspond to particles emitted in opposite directions in the center of mass system and which have an energy within a given range. The two directions chosen correspond to α particles emitted at 90° to the beam in the center of mass system. The apparatus consists of a fluid-tight vessel for receiving the sample to be analyzed, collimating means adapted to direct a substantially parallel beam of deuterons onto the sample, two detectors of α particles arranged in two directions having a precise angular correlation relative to the incident beam and associated with two measuring systems each of which is associated with one of the detectors, and a coincidence device. (B.L.M.)

30455 IMPROVEMENTS RELATING TO THE DETERMINATION OF OXYGEN DISTRIBUTION. Metcalf, Arnold (to Plessey-UK Ltd.). British Patent 1,114,416. May 22, 1968. Filed July 13, 1964.

A method and apparatus for determination of O distribution in material by activation of the O content of the material is described. The material is bombarded with high-energy neutrons to produce a radioactive isotope of N, and the high-energy γ radiation resulting from such activation is detected during the period when the radioactive isotope decays back to stable O. The γ radiation is received by some means, such as γ sensitive phosphor, that gives a visual record of the γ radiation. (B.L.M.)

30456 ACCURACY OF MASS SPECTROMETRIC ANALYSIS OF THE ISOTOPIC COMPOSITION OF ARGON. Shanin, L. L.; Chernyshev, I. V. Byull. Kom. Opred. Absol. Geol. Form., No. 8, 38-46 (1967). (In Russian).

Theoretical analysis of the errors in isotopic analysis of argon with a mass spectrometer of the MS type (double-collecting) showed the following errors: 0.3 percent for ^{36}Ar : ^{40}Ar in air; 1.1 to 1.4 percent for ^{36}Ar : ^{40}Ar in radiogenic argon; and 0.6 to 0.7 percent for ^{38}Ar : ^{40}Ar in the spiked sample. (Geophys. Abstr., No. 257, June 1968)

30457 ACTIVATION ANALYSIS OXYGEN DETERMINATION WITH FAST REACTOR NEUTRONS. Henkelmann, R.; Aumann, D. C.; Born, H.-J. (Technische Hochschule, Munich). Z. Anal. Chem., 233: 1-14(1968). (In German).

Oxygen can be determined by the nuclear reaction ^{16}O(n,p)^{16}N initiated by fast reactor neutrons. The automatic irradiation and counting system which is used in the Munich research reactor for nondestructuve oxygen determination is described. Activation by thermal neutrons is suppressed by the installation of a cadmium shield around the pneumatic tube at the irradiation position. Oxygen has been determined in the presence of many elements to find out which elements disturb the oxygen activation analysis. (auth)

30458 ANALYSIS OF RADIOGENIC ARGON BY ISOTOPE DILUTION WITH ^{38}Ar ENRICHED TRACER. Popov, Yu. N. Byull. Kom. Opred. Absol. Geol. Form., No. 8, 29-31(1967). (In Russian).

Adequate accuracy (± 2 percent) and great efficiency (6 determinations per 6-hr shift) were achieved in the isotope dilution analysis of argon with tracers enriched 5 to 6 percent in ^{38}Ar. (Geophys. Abstr., No. 257, June 1968)

30459 ATOMIC ABSORPTION ANALYSIS OF RUBIDIUM. Bakhov, A. S.; Lazarev, Yu. A.; Koka, P. A.; Naydenov, B. M. Byull. Kom. Opred. Absol. Geol. Form., No. 8, 107-9(1967). (In Russian).

The concentration of rubidium was determined with an atomic absorption spectrophotometer built from an EMR-3 monochromator with a three-sigma error of 0.9 percent and a sensitivity of 0.01 micrograms per ml. (Geophys. Abstr., No. 257, June 1968)

30460 COLORIMETRIC DETERMINATION OF BORON IN CARBON AND STAINLESS STEELS. Bell, D.; McArthur, K. (Glengarnock Steel Works, Scotland). Analyst, 93: 298-305(May 1968).

A method proposed for the colorimetric determination of boron in carbon and alloy steels, and probably also in high-nickel alloys, is described. The procedure was applied to several B.C.S. boron-containing steels with acceptable reproducibility and accuracy. (auth) (UK)

30461 DETERMINATION OF MICROGRAM QUANTITIES OF URANIUM, THORIUM, AND LEAD IN MINERALS WITH ION EXCHANGE RESINS. Shestakov, G. I. Byull. Kom. Opred. Absol. Geol. Form., No. 8, 124-30(1967). (In Russian).

The chromatographic separation of uranium, thorium, and lead in small concentrations from rocks and minerals in solution was found to be an important short-cut in the analysis of these elements by colorimetric or isotope dilution methods. (Geophys. Abstr., No. 257, June 1968)

30462 DETERMINATION OF THE RELATIVE CONTENT OF ^{235}U IN ENRICHED URANIUM BY ALPHA-GAMMA COINCIDENCE METHOD USING A GRIDDED IONIZATION CHAMBER. Miyajima, Mitsuhiro; (Waseda Univ., Tokyo); Doke, Tadayoshi. Radioisotopes (Tokyo), 17: 122-4(Mar. 1968).

Determination of the relative content of ^{235}U in slightly enriched U, using the cathode pulse for alpha-gamma coincidence in the detection system composed of a gridded chamber and a NaI scintillation counter, was studied. The relative content of ^{235}U was determined from the energy spectrum of the alpha-particles coincident with the gamma rays following alpha decay of ^{235}U. Two energy regions of the gamma rays, 125 to 175 keV and 175 to 225 keV, were selected for the alpha-gamma coincidence. The ratio of ^{235}U to ^{238}U in the enriched U was determined to be $4.42 \pm 0.18 \times 10^{-2}$ for the first energy range and $4.35 \pm 0.12 \times 10^{-2}$ for the second. These ratios are in good agreement with the value $(4.4614 \pm 0.0005 \times 10^{-2})$ determined by a mass spectrometer. (P.C.H.)

30463 DOUBLE-BEAM BALANCING METHOD FOR ISOTOPE-DILUTION ANALYSIS OF RUBIDIUM. Shchigolev, N. D. Byull. Kom. Opred. Absol. Geol. Form., No. 8, 104-6(1967). (In Russian).

It was found that isotope-dilution analysis of rubidium with a double-beam balancing technique using the MI-1301 mass spectrometer offers better accuracy than the conventional peak sweeping method. (Geophys. Abstr., No. 257, June 1968)

30464 DETERMINATION OF ANTIMONY IN ROCKS BY NEUTRON-ACTIVATION ANALYSIS. Brunfelt, A. O. (Univ. of Oslo); Steinnes, E. Analyst, 93: 286-8(May 1968).

Antimony was determined in some geochemical standards (andesite AGV-1, diabase W-1, dunite DTS-1, granite GB, and tonalite T-1) by neutron activation analysis. A radiochemical procedure was developed in which antimony(V) is extracted into isopropyl ether and subsequently back-extracted after reduction to the tervalent state with tin(II). The antimony activity is measured by γ spectrometry. Chemical-yield determination is carried out by reactivation. The precision of the method is better than 5 percent for samples with antimony content exceeding 1 ppM. (auth) (UK)

30465 DETERMINATION OF GOLD IN ROCKS BY NEUTRON ACTIVATION ANALYSIS USING FIRE-ASSAY PRECONCENTRATION. Simon, F. O.; Millard, H. T. Jr. (Geological Survey, Washington, D. C.). Anal. Chem., 40: 1150-2(June 1968).

By irradiation of the lead button obtained by the fire-assay procedure prior to the addition of Ag, a uniform, dilute, and reproducible matrix for the neutron irradiation of Au is provided. The method also reduces the counting background due to ^{110m}Ag, and avoids the possibility of introducing gold contamination with the Ag. After irradition, Ag is added, the lead button cupelled, and the ^{198}Au counted instrumentally without further separations. The sources of error in this method differ from those in conventional neutron activation analysis. (P.C.H.)

30466 DETERMINATION OF TRACE AMOUNTS OF CHROMIUM BY STABLE ISOTOPE DILUTION-MASS SPECTROMETRY. Hedley, A. (Naval Ordnance Inspection Establishment, Sheffield, Eng.). Analyst, 93: 289-91(May 1968).

A simple chemical–mass-spectrometric method for the determination of chromium is described. The method was applied to steels and copper-base and aluminium-base alloys. The conditions for the thermal ionization of chromium are given, and the stable isotope-dilution technique was used for quantitative analysis over the range 0.003 to 0.2 percent. The advantage of the isotope-dilution technique in not requiring quantitative extraction is clearly illustrated by the application of a single method to more than one type of alloy. (auth) (UK)

30467 DETERMINATION OF TRACE NICKEL, MANGANESE, COBALT, AND IRON IN ZINC SULFIDE PHOSPHOR BY NEUTRON ACTIVATION. Persiani, C.; Cosgrove, J. F. (Research Center of General Telephone and Electronics Labs., Inc., Bayside, N. Y.). Electrochem. Technol., 6: 205-7(May-June 1968).

The luminescent properties of zinc sulfide are adversely affected by the presence of such elements as cobalt, nickel, manganese, and iron. A method is described that possesses high sensitivity and permits the simultaneous determination of these elements in zinc sulfide. The technique utilizes thermal neutron activation in combination with solvent extraction and ion exchange separation. Results are compared to optical methods of analysis. (auth)

30468 DONOR PROPERTIES OF PYROPHOSPHATE DERIVATIVES. COMPLEXES OF RARE EARTH IONS WITH OCTAMETHYLPYROPHOSPHORAMIDE. Joesten, Melvin D.; Jacob, Robert A. (Univ. of Southern Illinois, Carbondale). Advan. Chem. Ser., 71: 13-24(1967).

From Symposium on Lanthanide/Actinide Chemistry, New York. See CONF-660962.

Complexes of rare earth ions with octamethylpyrophosphoramide (OMPA) were prepared and characterized. The stoichiometry of the complexes is either $Ln(ClO_4)_3 \cdot 3\ OMPA \cdot x\ H_2O$ where Ln is La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, and Y, and x is 1 to 4 or $Ln(ClO_4)_3 \cdot 4\ OMPA \cdot x\ H_2O$ where Ln is La, Eu, and Ho, and x is 0, 1, or 4. The infrared spectra of both types of complexes are interpreted on the basis of a coordination number of eight or more for the lanthanide ions. (auth)

30469 EXTRACTION OF SELENO-CYSTATHIONINE AND IDENTIFICATION BY ACTIVATION ANALYSIS. Olivares, Gilberto J. (Univ. del Zulia, Maracaibo, Venezuela). Acta Cient. Venez., 18: 9-12(1967). (In Spanish).

A method is presented for the assay of selenium by neutron activation, by formation of the metastable isotope ^{77}Se (0.16 MeV, 17.5 sec half-life). The method was applied to water extracts of nuts of *Lecythis ollaria*. They were dialyzed, the dialysate was concentrated in volume, and it was chromatographed on a Dowex-50 ion exchange column. Assay of Se revealed only one amino acid containing Se (seleno-cystathionine), that was isolated and purified by recrystallization. In the neutron activation technique described, the sample containing the stable ^{76}Se was exposed for one min to a neutron flux of about 1×10^{11} n/cm^2 sec along with standards containing 0.05 to 0.1 mg of Na_2SeO_4, equivalent to 20.9 to 41.8 μg of Se. Thirty sec after irradiation the resulting ^{77m}Se was counted for one min, and one min later was counted again. The difference in the two counts at the 0.16-MeV photopeak represented the amount of Se present. (BBB)

30470 INDIRECT AMPLIFICATION PROCEDURE FOR THE DETERMINATION OF NIOBIUM BY ATOMIC-ABSORPTION SPECTROSCOPY. Kirkbright, G. F.; Smith, A. M.; West, T. S. (Imperial Coll. of Science and Tech., London). Analyst, 93: 292-7(May 1968).

Niobium in the range 5 to 50 μg was determined by an amplification procedure in which molybdoniobophosphoric acid is formed and extracted into butanol. The molybdophosphoric acid, which is also formed, is first selectively extracted away from the molybdoniobophosphoric acid into isobutyl acetate. The eleven molybdate ions associated with each niobium atom are determined by direct atomic-absorption spectroscopy in a nitrous oxide–acetylene flame at 313.2 nm. Of the twenty-eight other ions studied, only titanium caused appreciable interference, although its presence at the same concentration as niobium can be tolerated. Large amounts of tantalum do not interfere. (auth) (UK)

30471 MASS SPECTROGRAPHY APPLICATION TO THE DETECTION AND METERING OF HYDROGEN IN A LIQUID SODIUM LOOPS. Lannou, L. Bull. Dir. Etud. Rech., No. 4, 161-85(1967). (In French).

The principle of a new hydrogen detection and metering method in liquid sodium by mass spectrography is demonstrated. Its main qualities (it is specific, simple, rapid in use and, especially, sensitive) make it particularly promising as a mean of solving the leak detection problem in a liquid sodium-heated steam generator. A general investigation program now being developed on the subject is described, which is concerned with the specific problem of leak detection and various applications of the method. The (essentially experimental) initial results obtained are described, which are associated with possible applications of the method in a liquid sodium loop. (auth)

30472 MICRODETERMINATION OF CALCIUM, STRONTIUM, AND BARIUM USING THE RING-OVEN METHOD. Ghose, Animesh K.; Dey, Arun K. (Univ. of Allahabad, India). Z. Anal. Chem., 234: 185-8(1968).

The ring-oven technique was used for the identification and determination of Ca, Sr, and Ba in the micro scale. The elements were first converted into their nitrates and Ca was washed out by a mixture of absolute alcohol and ether. Sr was then separated from Ba as soluble diethyldithiocarbamidate in alcohol–ether. The rings obtained were developed by rhodizonate (Sr, Ba) and pyrogallol (Ca). Quantitative determinations are possible by comparison with standard rings. Ca(0.60(μg), Sr(1.31 μg), and Ba(8.24 μg) were determined with an error lower than 6%. (auth)

30473 NEUTRON ACTIVATION ANALYSIS. Simpson, H. (United Kingdom Atomic Energy Authority, Wantage, Eng.). Chem. Process. (London), 14: S31-6(May 1968).

The review is presented under the following topics: radiochemical separations; gamma spectrometry; applications of neutron activation analysis; future trends; neutron generators; and radioisotope neutron sources. (UK)

30474 NEUTRON ACTIVATION DETERMINATION OF VANADIUM IN IRON METEORITES AND SULFIDE NODULES. Linn, T. A. Jr. (Arizona State Univ., Tempe); Moore, C. B.; Schmitt, R. A. Geochim. Cosmochim. Acta, 32: 561-4(May 1968).

The concentrations of vanadium in five meteoritic irons in nine sulfide nodules from iron meteorites were determined. An instrumental method was employed, using neutron activation without radiochemical separation. (auth) (UK)

30475 NUCLEAR METHODS. Contributed Papers and Discussion. Guinn, Vincent P. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). pp 337-46 of Trace Characterization: Chemical and Physical. Meinke, W. Wayne; Scribner, Bourdon F. (eds.). Washington, D. C., National Bureau of Standards, 1967.

From 1st Materials Research Symposium on Trace Characterization: Chemical and Physical, Gaithersburg, Md. See CONF-661008.

Topics discussed include: neutron, photonuclear, and charged-particle activation analysis and other nuclear methods. (M.C.G.)

30476 PROBLEM OF MEASUREMENT OF RADIOGENIC ARGON. Chedzhemov, G. Kh. Byull. Kom. Opred. Absol. Geol. Form., No. 8, 22-8(1967). (In Russian).

No particular advantage was found in the use of ^{38}Ar as a tracer as opposed to air–argon in isotope dilution analysis of radiogenic argon. (Geophys. Abstr., No. 257, June 1968)

30477 POTENTIOMETRIC DETERMINATION OF RARE EARTHS WITH SODIUM ORTHO-VANADATE. Shivahare, G. C.; Joshi, N. D. (Univ. of Jodhpur, India). Z. Anal. Chem., 234: 114-15(1968).

The addition of sodium orthovanadate solution to that of a rare earth results in the precipitation of sparingly soluble orthovanadate of the rare earth. The reaction can be followed quantitatively with potentiometric detection of the end-point using a glass electrode. La, Ce, Pr, Nd, and Sm were determined by this method. The accuracy was very good even at low concentrations. (M.C.G.)

30478 RADIOACTIVITY TECHNIQUES IN TRACE CHARACTERISATION. Smales, A. A. (Atomic Energy Research Establishment, Harwell, Eng.). pp 307-36 of Trace Characterization: Chemical and Physical. Meinke, W. Wayne; Scribner, Bourdon F. (eds.). Washington, D. C., National Bureau of Standards, 1967.

From 1st Materials Research Symposium on Trace Characterization: Chemical and Physical, Gaithersburg, Md. See CONF-661008.

Activation analysis and the use of radioactive materials as tracers for an element or compound are considered. Topics covered include: activating agents and irradiation facilities, prompt radiation techniques, radiochemical separations, instrumentation, accuracy and precision, isotope dilution, isotopic exchange, isotope derivatives and derivative dilution, isotope displacement, and radiometric titration. (M.C.G.)

30479 REACTION AND DETERMINATION OF URANYL IONS BY MEANS OF PYROGALLOL SULFONIC ACID. Horak, J.; Okac, A. (Purkyne-Univ., Brno). Collect. Czech. Chem. Commun., 33: 304-8(Jan. 1968). (In German).

In pyrogallolsulfonic acid, the formation of uranyl complexes with the ratio M : R = 1 : 1, 2 : 2, and 1 : 2 were established potentiometrically. Spectrophotometric studies showed only the 1 : 1 and 1 : 2 complexes. The absorption curves, the pH extinction curves, and curves showing the dependence of the extinction on the reagent concentration were given. For the qualitative determination of UO_2^{2+}, a weakly alkaline sodium acetate medium is best as the masking reagents do not interfere. The steps in the photometric determination of UO_2^{2+} are outlined. (J.S.R.)

30480 RADIOGENIC ARGON DETERMINATION BY THE ACTIVATION METHOD. Soroyu, M.; Cherey, M. Byull. Kom. Opred. Absol. Geol. Form., No. 8, 80-1(1967). (In Russian).

The nuclear activation method of ^{40}Ar analysis that is described permits the determination of 10^{-9} grams of Ar with an error no greater than 20 percent and quantities in excess of 10^{-8} grams with an error less than 3 percent. (Geophys. Abstr., No. 257, June 1968)

30481 SPECTROPHOTOMETRIC DETERMINATION OF SMALL AMOUNTS OF PHOSPHORUS IN IRON AND STEEL BY SOLVENT EXTRACTION. Kayami, Tadashi; Honjo, Katsuhiko (Okayama Univ., Japan). Bunseki Kagaku, 15: 816-21(1966). (In Japanese).

Standards were prepared for the determination of Zr, Nb, and Hf (0.001 to 0.3%) in mild steel by dissolving electrolytic iron plus additions of the appropriate metals in HCl and in HBF_4. After evaporating the solution to dryness, the residue was ground to <200 mesh. With the aid of such standards, secondary standards were eventually prepared. For major constituents, the use of solutions dried on filter-paper was examined; unexpected results included enhancement of the Co emission by Fe and of Fe emission by Cr, and non-enhancement of the Fe emission by Ni. Major elements were determined from ratios obtained under conditions of equivalent excitation when only a single standard was available. Computer techniques were also examined for the determination of minor and major constituents when sufficient standards were available. (Anal. Abstr., Vol. 15, No. 5, 1968)

30482 STUDIES IN ATOMIC-FLUORESCENCE SPECTROSCOPY. IV. THE ATOMIC-FLUORESCENCE SPECTROSCOPIC DETERMINATION OF SELENIUM AND TELLURIUM. Dagnall, R. M.; Thompson, K. C.; West, T. S. (Imperial Coll. of Science and Tech., London). Talanta, 14: 557-63(May 1967).

Selenium and tellurium were determined down to 0.25 and 0.12 ppM, respectively, by measuring the atomic-fluorescence signals at 2040 Å and 2143 Å, respectively. Other possible wavelengths of measurement were considered and the effects of some extraneous ions were examined. Microwave-excited electrodeless discharge tubes were used as spectral sources, and intensity measurements were made with a Unicam SP900A atomic-absorption/flame–emission spectrophotometer. Atomic-absorption measurements were also made with the same sources and spectrophotometer. The advantages of atomic-fluorescence methods and the use of electrodeless discharge tubes are discussed. (auth) (UK)

30483 SPECTROGRAPHIC DETERMINATION OF IMPURITIES IN URANIUM MATERIALS BY FRACTIONAL CARRIER DISTILLATION. Capdevila, C. (Junta de Energia Nuclear, Madrid). An. Real. Soc. Espan. Fis. Quim. (Madrid), Ser. B, 8: 155-8(1967). (In Spanish).

The carrier-distillation technique has been modified to improve the sensitivity. Electrodes 9.5 mm in dia with a cavity 10 mm deep × 7 mm in dia were used, with 300 mg of test mixture. Satisfactory carriers are AgCl, AgCl–AgF (3 : 1), and $AgCl–Ga_2O_3$ (4 : 3). The effects of the intensity of the arc current, the concentration of carrier and the time of exposure have been studied. Palladium, In, and Ag were used as internal standards. The elements determined were Al, As, B, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, P, Pb, Si, Sn, Ti, and V (0.01 to 30 ppM). (Anal. Abstr. Vol. 15 No. 5, 1968)

30484 SPECTROPHOTOMETRIC DETERMINATION OF NICKEL, COBALT, COPPER, IRON, AND ZINC IN NIOBIUM. Grossmann, O. (Institut fuer Metallphysik and Reinstmetalle, Dresden); Grosse-Ruyken, H. Z. Anal. Chem., 233: 14-20 (1968). (In German).

Traces of nickel, cobalt, copper, iron, and zinc are separated from niobium as diethyldithiocarbamidate complexes by extraction. Thereafter these elements are separated from each other by ion-exchange chromatography and determined spectrophotometrically. Amounts of 0.3 ppM of nickel, copper, iron, and zinc and of 0.1 ppM of cobalt can be determined in 0.5 g of niobium. The relative standard deviations vary from 4 to 24% for the different elements in dependence of the contents of impurities. (auth)

30485 SPECTROPHOTOMETRIC DETERMINATION OF MOLYBDENUM. Tarayan, V. M.; Pogosyan, A. N. (Erevan State Univ.). Arm. Khim. Zh., 19: 586-9(1966). (In Russian).

A method for the determination of Mo is based on the formation of a Cl^- complex of Mo(V). The test solution was prepared by reducing $0.01\underline{M}$ $(NH_4)_6Mo_7O_{24}$ in $1.5\underline{M}$ HCl with $0.025\underline{M}$ hydrazine HCl in excess. This solution was made $5\underline{M}$ in HCl, and the extinction coefficient was measured at 305 nm. Beer's law was obeyed for concentrations of Mo from $8\underline{M}$ to 0.2 m$\underline{M}$. There was no interference from Cu^{2+}, Mn^{2+}, Ni^{2+}, Co^{2+}, Cr^{3+}, V^{5+}, and Ti^{3+}, but Fe^{2+}, Fe^{3+}, and W^{6+}, at concentrations >1m$\underline{M}$ interfered. The method is suggested as a basis for the determination of Mo in the presence of equal amounts of W. (Anal. Abstr.) (TSS)

30486 TRIPLE BACKSCATTERING OF ELECTRONS. Boyarshinov, L. M. (Moscow Inst. of Steel and Alloys). Dokl. Akad. Nauk SSSR, 178: 573-6(Jan. 1968). (In Russian).

The sensitivity of chemical analysis by electron backscattering should be much greater with triple backscattering than with single or double backscattering. Two sources each containing 2 mCi of thallium-204 are mounted over the sample. The sources are shielded so that only backscattered electrons strike another sample of the same material. After a third reflection from the surface of the first sample the triply backscattered electrons are counted on a thin-window (1 mg/cm^2) G–M tube after passage through an Al filter. Disks of the sample material are placed parallel to each other. The maximum energy of the triply scattered electron E_S is given by the formula: $E_S = 0.70\ Z^{0.43}E_0$, where E_0 is the maximum energy of the source electrons and Z is the atomic number of the scattering material. The intensity of triply scattered electrons as a function of Z can be expressed by the following power function $I = AZ^n$, where A is a constant depending on source activity, the maximum beta energy, and geometry. The value of n for triple backscattering varies from 2.30 at an absorber thickness of 9 mg/cm^2 to 2.84 at an absorber thickness of 25 mg/cm^2. The value of n is 0.67 for single backscattering and 1.80 for double backscattering. It should be possible to develop sensitive methods of analyzing two-component mixtures and chemical compounds by this method. (TTT)

30487 ULTRAVIOLET SPECTROPHOTOMETRIC STUDY OF THE DETERMINATION OF CADMIUM, COBALT, BISMUTH, AND

MOLYBDENUM BY THE PYRROLIDINEDITHIOCARBAMATE METHOD. Kalt, Melvyn B.; Boltz, D. F. (Wayne State Univ., Detroit). Anal. Chem., 40: 1086-91(June 1968).

Ammonium pyrrolidinedithiocarbamate has been investigated as a reagent for the spectrophotometric determination of certain metals. Pyrrolidinedithiocarbamic acid forms metal chelates which are soluble in chloroform, methylisobutyl ketone, and other organic solvents. The extracted pyrrolidinedithiocarbamates of cadmium, cobalt, bismuth, and molybdenum have absorbance maxima in the ultraviolet region. The main advantage of pyrrolidinedithiocarbamate is that it can be used in acidic solutions. Procedures have been developed for the ultraviolet spectrophotometric determination of these elements. The molar absorptivities range from 3.50×10^4 l/mole-cm for the cadmium chelate to 8.5×10^3 for the molybdenum system. (auth)

30488 URANIUM DETECTION IN DIETHYL ETHER AND FLUORIMETRIC SPOT TEST FOR URANIUM IN AQUEOUS SOLUTIONS. Kleber, Helmut Z. Anal. Chem., 234: 115-18(1968). (In German).

The reaction of tannin with uranium to produce a brown color or a brown precipitate was used for determination of uranium in ethyl ether. The green luminescence formed by uranium in the presence of sodium polyphosphate was used for fluorimetric determination of uranium in aqueous solutions. (M.C.G.)

30489 X-RAY FLUORESCENCE ANALYSIS. Wilde, W. (Humbolt Univ., Berlin). Z. Chem., 7: 6-11(1967). (In German).

A review of the theory and practice of the technique is presented. (41 references.) (Anal. Abstr., Vol. 15, No. 5, 1968)

30490 TRACE CHARACTERIZATION: CHEMICAL AND PHYSICAL. Based on Lectures and Discussions of the 1st Materials Research Symposium Held at the NBS, Gaithersburg, Maryland, October 3-7, 1966. Meinke, W. Wayne; Scribner, Bourdon F. (eds.). National Bureau of Standards Monograph 100. Washington, D. C., National Bureau of Standards, 1967. 596p. GPO $4.50. (NBS-MON-100; CONF-661008).

Texts of invited lectures and summaries of contributed papers and discussion sessions are presented. Topics covered include: trace characterization and properties of materials, electric measurements, electrochemical methods, optical and x-ray spectroscopy, x-ray diffraction, optical methods, chemical spectrophotometry, nuclear methods, mass spectroscopy, preconcentration, sampling and reagents, and electron and optical microscopy. Separate abstracts were prepared for two sections. (M.C.G.)

For abstracts of individual sections see: 30475 and 30478.

30491 MASS SPECTROMETRIC DETERMINATION OF URANIUM CONCENTRATIONS IN POTABLE WATERS OF NEW YORK STATE. Levin, Arthur A. Troy, N. Y., Rensselaer Polytechnic Inst., 1967. 141p.

Thesis.

Water samples were obtained from seven lakes in two geographical locations in New York State; (1) Lake Ontario and the Finger Lakes region; including Cayuga, Oneida, and Skaneateles Lakes, and (2) the Adirondack region; including Lake George, Loon Lake, and Schroon Lake. A four stage mass spectrometer was used for the analyses of the U concentrations of the water samples in conjunction with the method of isotope dilution. This procedure included addition of a known quantity of an enriched ^{235}U tracer to an aliquot of each sample, followed by a chemical processing. The chemistry included several ether extractions, which recovered 99% of the U from each water sample. The U concentrations in the Finger Lakes were found to be 0.19 μg/l to 0.35 μg/l, and Lake Ontario measured 0.42 μg/l. These concentrations were an order of magnitude greater than in the Adirondack Lakes, which were 0.01 μg/l to 0.02 μg/l, while the U concentrations within each region were comparable. This significant regional variation of U concentrations in these lakes, in relation to the two geographical locations, is tentatively attributed to geological influences, as governed by the different types of bedrock and glacial overburden comprising the drainage basins of the two areas. The possible contribution from fertilizers upon the uranium concentrations throughout the state was also considered, as the Finger Lakes region has considerably more agricultural activity than the Adirondacks. Limnologically, the Adirondack Lakes are of the oligotrophic type, while Lake Ontario and the Finger Lakes are categorized as eutrophic lakes. This difference in limnology, between the two geographical regions, is a reason to suspect that an environmental base line of U may be influenced in some manner by microbial action. However, the incorporation of U into the biosphere is complex, and without further study specific ecological correlations cannot be made. (Diss. Abstr.)

30492 AMPEROMETRIC TITRATION OF MOLYBDENUM(VI) BY VANADIUM(II) AND CHROMIUM(II). Nikolaeva, E. R.; Agasyan, P. K.; Tarenova, K. Kh. Vestn. Mosk. Univ., Ser. II. Khim., No. 2, 135-9(Mar.-Apr. 1968). (In Russian).

The possibility of using two polarized platinum or tungsten and a pair of (+) W-Pt(-) electrodes at ΔE about 100 mV for amperometric titration of molybdenum(VI) by vanadium(II) and chromium(II) standard solutions has been found. The method has been applied to the analysis of (steel and) alloys with different content of molybdenum(VI) after separation of iron. (auth)

30493 LYUMINESTSENTNYE METODY OPREDELENIYA URANA. (Luminescence Methods for Determining Uranium). Dobrolyubskaya, T. S. Moscow, Izdatel'stvo Nauka, 1968. 96p.

The relation between the luminescence of uranium and its chemical behavior was analyzed and luminescence methods for determining uranium of various valences are discussed. The luminescence of liquid and solid uranium(VI) solutions, and uranyl salts and minerals are reviewed. Descriptions are given of the luminescence devices and instruments used for determining uranium. 317 references are included. (R.V.J.)

30494 SOME NEW APPLICATIONS OF HIGH FREQUENCY EXCITATION TUBES IN ATOMIC ABSORPTION SPECTROPHOTOMETRY. Ivanov, N. P.; Kozyreva, G. V. Vestn. Mosk. Univ., Ser. II. Khim., No. 2, 127-30(Mar.-Apr. 1968). (In Russian).

A study of In, Ga, Tl, Sc, Te, Sb, Bi, Pb, and Sn absorption spectra has been carried out by high-frequency excitation tubes without electrodes. The determination sensitivity of these elements for air-propane and air-acetylene flames and for horizontal flames of organic solvents has been determined. (auth)

30495 SPECTROPHOTOMETRIC STUDY OF MOLYBDENUM HETEROPOLYACIDS OF TITANIUM AND ZIRCONIUM. Shakhova, Z. F.; Semenovskaya, E. N. Vestn. Mosk. Univ., Ser. II. Khim., No. 2, 122-6(Mar.-Apr. 1968). (In Russian).

Yellow complexes of titanomolybdenum (TMA) and zirconomolybdenum (ZMA) heteropolyacids have been studied by spectrophotometry in solutions of acetic acid and various inorganic acids. The reduction of TMA and ZMA by reagents of different activity has been investigated. The formation of TMA and ZMA in the solutions of both "yellow" and "blue" forms can be used in photometric determination of Ti and Zr. (auth)

30496 RADIOISOTOPE METHODS OF SULFUR DIOXIDE MEASUREMENTS. Cho, Boong Y. (Industrial Nucleonics Corp., Columbus, Ohio); Evans, Howard J.; Anderson, Larry B. Trans. Amer. Nucl. Soc., 11: 55-6(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30497 ACTIVATION ANALYSIS OF NORMAL AND ATHEROSCLEROTIC AORTAS FROM RATS AND MAN. Strain, William H. (Univ. of Rochester, N. Y.); Rob, Charles G.; Pories, Walter J.; Childers, Richard C.; Hennessen, John A.; Thompson, Maxwell F. Jr.; Graber, Francis M. Trans. Amer. Nucl. Soc., 11: 62-3 (June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30498 NEUTRON-ACTIVATION AUTORADIOGRAPHIC STUDIES OF GOLD DISTRIBUTION IN BAND-SHAPED GERMANIUM DENDRITES. Kalnach, L. P.; Graudinya, L. Ya.; Ozols, A. E. (Inst. of Physics, Riga). Izv. Akad. Nauk SSSR, Neorg. Mater., 4: 643-9(May 1968). (In Russian).

Neutron activation analysis was made of gold distribution in band-shaped germanium dendrites. It was found that dendrite bands with perfect wide facets are evenly alloyed to the depth of the strongly alloyed regions. The gold distribution in strongly alloyed regions depends on the binary structure, dendrite geometry, and the amount of alloying on the studied material. (R.V.J.)

30499 NEUTRON-ACTIVATION DETERMINATION OF GOLD IN MOUNTAIN ROCK WITH USE OF SUBSTOICHIOMETRIC SEPARATION. Rakovskii, E. E.; Serebryanyi, B. L. Radiokhimiya, 10: 75-81(1968). (In Russian).

A method for the neutron activation determination of small quantities of Au in natural samples was developed using substoichiometric extraction of triphenylguanidine tetrachloroaurate with dichloroethane. (tr-auth)

30500 DETERMINATION OF THE CONCENTRATION OF HAFNIUM AND ZIRCONIUM. III. Perovskii, A. P. Radiokhimiya, 10: 70-4(1968). (In Russian).

A new neutron activation method for the determination of the concentration of Hf and Zr is described. It is based on the different decay schemes of the isotopes ^{180m}Hf and ^{97}Zr. The possibility of sharply curtailing the time for obtaining results, eliminating work on the preparation of samples for measurement, confidently performing measurements in the area of low Hf concentrations, and reducing the neutron flux density for activation are given. (tr-auth)

30501 DETECTION OF POLLUTANTS IN AIRBORNE PARTICULATES BY ACTIVATION ANALYSIS. Lee, James (Ontario Dept. of Health, Toronto); Jervis, Robert E. Trans. Amer. Nucl. Soc., 11: 50-1(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30502 NEUTRON ACTIVATION DETERMINATION OF TRACE MERCURY IN CANADIAN FOODS. Rayudu, G. V. S.; Tiefenbach, B.; Jervis R. E. (Univ. of Toronto). Trans. Amer. Nucl. Soc., 11: 54-5(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 30479, 30651, 30768, 31501, and 31502.

30503 (AAEC/TM-447) HIGH TEMPERATURE rH-pH DIAGRAMS FOR THE SYSTEM URANIUM(VI) NITRATE-WATER. Edenborough, B. W.; Robins, R. G. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Apr. 1968. 20p. Dep.

A method for calculating thermodynamic equilibrium relations in the system U(VI) nitrate-water up to 300°C is presented, and rH-pH diagrams constructed for temperatures of 25, 60, 100, 150, 200, and 300°C (rH = logarithm of the partial pressure of hydrogen gas). The method involves the use of the "correspondence principle" and takes into account activity-concentration relations and the effect of added nitric acid. (auth)

30504 (ANL-7404) PROGRAMS FOR ATOMIC-STRUCTURE CALCULATIONS. Fischer, C. Froese; Wilson, M. (Argonne National Lab., Ill.). Jan. 1968. Contract W-31-109-eng-38. 59p. Dep. CFSTI.

Computer programs used for atomic-structure calculations are described and listed. Sample data for each are also presented. (auth)

30505 (JEN-177-DMe/1-22) CONTRIBUCION AL ESTUDIO DE LA CARBURACION GASEOSA DEL URANIO. (Contribution to the Study of the Gaseous Carburation of Uranium). Esteban, J. Antonio; Jimenez, J. M.; De Villota, P. (Junta de Energia Nuclear, Madrid (Spain)). 1966. 21p. (In Spanish). Dep.

Thermal decomposition of uranium hydride powder obtained by hydrogenation of uranium turnings was studied. Carburization of the uranium hydride or metallic uranium powder with methane was also studied. A method of uranium monocarbide fabrication under static atmosphere is described. Hydrogen is removed by means of an uranium getter. The effects of some parameters such as temperature, initial pressure, raw material, etc., on the reaction $U \pm CH_4 \rightleftharpoons UC \pm 2H_2$ were also studied. (auth)

30506 (NP-17479) BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF GASES AND PLASMAS. Brewer, L. (comp.) (California Univ., Berkeley. International Union of Pure and Applied Chemistry. Commission on High Temperature and Refractories). Mar. 31, 1968. 37p. NBS, Washington, D. C. Free.

One hundred and sixty-three references are presented under two headings: spectroscopy of interest to high-temperature chemistry and reaction between gases and condensed phases. (M.C.G.)

30507 (ORNL-TM-2163) MASS TRANSFER OF WATER FROM SINGLE THORIA SOL DROPLETS FLUIDIZED IN 2-ETHYL-1-HEXANOL. Clinton, Sam D. (Oak Ridge National Lab., Tenn.). June 1968. Contract W-7405-eng-26. 112p. Dep. CFSTI.

Thesis. Submitted to Univ. of Tennessee, Knoxville.

The rate at which water is extracted from thoria sols was investigated by fluidizing single thoria sol droplets in 2-ethyl-1-hexanol and measuring the diameter of a droplet over a period of time until shrinkage no longer occurred. Diameter data from both water and sol drops were obtained at 25°C. The experimental variables were drop diameter (0.1 to 0.2 cm), sol molarity (0 to 2.5 $\underline{M}$ ThO_2), and water concentration in the bulk solvent (2 to 12 mg of water per cc of solvent). A linear relationship was found for the water and sol droplet data. In this relationship, the Sherwood number was plotted against the product of Reynolds number raised to the $\frac{1}{2}$ power and the Schmidt number raised to the $\frac{1}{3}$ power. The common correlation for the fluidized water and sol drops verified a proposed mass-transfer model, which assumes that an organic-phase film surrounding the drop is the rate-controlling resistance. The sphere Reynolds number was based on an average organic fluidizing velocity and varied from 0.2 to 7. The Schmidt number for the system was fixed at 35,700. During the extraction of water, the mass transfer coefficients for fluidized sol drops were shown to depend only on the increasing thoria concentration or molarity. By expressing the mass transfer coefficients as a function of the density difference between the sol and the 2-ethyl-1-hexanol, an equation was derived to predict the gelation time required for any initial sol molarity and drop diameter. (auth)

30508 (RFP-1136) ELECTROLYTIC DISSOLUTION OF PLUTONIUM IN NITRIC ACID. Berry, James W.; Miner, Frend J. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). May 3, 1968. Contract AT(29-1)-1106. 9p. Dep. CFSTI.

The rate of dissolution of plutonium metal in nitric acid-fluoride systems using electrolysis was determined as a function of nitric acid concentration, fluoride concentration, and current density. Other parameters investigated included type of current and type of metal. The optimum conditions for rapid dissolution were found to be high nitric acid concentration (15.0$\underline{M}$) and a high applied current (10 A). Fluoride concentration, over the range investigated (0.01 to 0.13$\underline{M}$), was found to have little effect on the dissolution rate, although its presence is necessary. Analysis of the off-gases showed the hydrogen concentration to be near background concentration. (auth)

30509 (RT/MET-(68)1) CARATTERIZZAZIONE PER DIFFRAZIONE DEI RAGGI X A BASSO ANGOLO DI OSSIDO DI TORIO COLLOIDALE. (Characterization of Thorium Oxide Colloids by Low-Angle X-Ray Diffraction). Cabrini, A.; Celotti, G.; Zannetti, R. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1968. 43p. (In Italian). Dep.

Low-angle x-ray scattering was used for studies of colloidal solutions in the sol-gel processes. Theoretical background of this method is described. The feasibility of obtaining the shape, the mean particles size, and the specific surface of gels is considered. This method is applied to correlate these characteristics to the system for preparation of sols and to make some assumption on the structure of gels. The results of examinations of electron microscope and BET measurements are also reported and discussed. (auth)

30510 (UCRL-Trans-10236) INVESTIGATION OF THE AQUEOUS SOLUTIONS OF THORIUM PERCHLORATE. Rigin, V. I. Translated by A. Mincer for Univ. of California Lawrence Radiation Lab., Livermore, from Tr. Sib. Tekhnol. Inst., No. 36, 79-81(1963). 10p. Dep. CFSTI.

Thorium perchlorates were prepared and their behavior in aqueous solutions was studied. The hydrolysis of thorium was studied in a perchlorate medium at an ionic strength $\mu = 3$, and the type of predominant ion was established. (M.C.G.)

30511 RADICAL IONS. Kaiser, E. T.; Kevan, L. (eds.). Reactive Intermediates in Organic Chemistry. New York, John Wiley and Sons, Inc., 1968. 809p. $30.00.

Thirteen chapters are included; separate abstracts were prepared for 3. The remaining 10 chapters contain information on: electron spin densities; metal ketyls and related radical ions—electron structures and ion pair equilibria; semidione radical anions; radical cations; orbital degeneracy in benzene and substituent effects; advances in the chemistry of aromatic anion radicals; organometallic radicals and ion radicals of the Group IV elements; radical anions of sulfur-containing aromatic compounds; structure of inorganic radicals; and electron spin resonance of first row transition metal complex ions. Separate author and subject indexes are included. (P.C.H.)

For abstracts of individual chapters see: 30606-30608.

30512 SOLUBILITY OF SODIUM CARBONATE IN SODIUM METAL. Hill, Eugene F. (Atomic Power Development Associates, Inc., Detroit). Trans. Amer. Nucl. Soc., 11: 113-14 (June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30513 DIFFUSION OF IODINE IN URANIUM MONOCARBIDES. Castleman, A. W. Jr.; Munkelwitz, H. R. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc., 11: 155-6(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30514 RECENT ADVANCES IN ACTINIDE AND LANTHANIDE CHEMISTRY. Bagnall, K. W. (Atomic Energy Research Establishment, Harwell, Eng.). Advan. Chem. Ser., 71: 1-12(1967).

From Symposium on Lanthanide/Actinide Chemistry, New York. See CONF-660962.

The chemistry of the lighter actinides from thorium to americium, all being available in substantial quantities, is now well understood. In the 4+, or higher oxidation states, these elements are best considered as an inner transition series. Their chemistry shows both horizontal similarities within the actinide group and to a lesser degree, some vertical similarities with the group 4, 5, and 6 d-transition elements. All of the actinides in their 3+ oxidation states behave in much the same way as the lanthanides. The chemistry of the actinides is reviewed within this context and compared with the corresponding lanthanides. (104 references). (auth)

30515 ACTINIDE(IV) N,N-DIETHYLDITHIOCARBAMATE COMPLEXES. Bagnall, K. W.; Brown, D.; Holah, D. G. (Atomic Energy Research Establishment, Harwell, Eng.). J. Chem. Soc., A, No. 5, 1149-(1968).

N,N-Diethyldithiocarbamate complexes, M dtc_4 (M = Th, U, Np, and Pu) were prepared in nonaqueous media, but the protactinium(IV) compound could not be isolated. The four compounds were isomorphous, and the uranium compound was monoclinic, space group C2/c (C_{2h}^6). Infrared spectral measurements between 200 and 4000 cm^{-1} are consistent with bidentate dithiocarbamate groups. The uranium compound was monomeric in benzene, and the metal ion was probably eight-co-ordinate. Spectra in benzene solutions, between 6000 and 30,000 cm^{-1}, were recorded. Similar complexes with ethyl xanthate, cis-1,2-dicyano-1,2-ethylenedithiol, and toluene-3,4-dithiol could not be isolated. (auth) (UK)

30516 A CONTRIBUTION TO THE STUDY OF THE OXIDATION POTENTIAL OF THE BERKELIUM(III)-(IV) COUPLE IN VARIOUS MEDIA. Musikas, C.; Berger, R. (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France). Advan. Chem. Ser., 71: 296-307(1967).

From Symposium on Lanthanide/Actinide Chemistry, New York. See CONF-660962.

Indirect determinations of the formal oxidation potential of a Bk(IV) – Bk(III) couple in sulfuric and nitric acids were made by tracer measurement. From the Bk(IV)/Bk(III) ratios and the corresponding Ce(IV)/Ce(III) ratios at equilibrium conditions the oxidation potential of the Bk(IV) – Bk(III) couple can be calculated. The Bk(IV)/Bk(III) ratio can be determined by extracting Bk(IV) by an appropriate organic solvent. The formal oxidation potentials of the Bk(IV) – Bk(III) couple in 1 and 0.5N sulfuric acid were found to be 1.42 and 1.44 volts using trilaurylmethylammonium sulfate in carbon tetrachloride as a solvent. In 6N nitric acid the oxidation potential of the couple was found to be 1.56 volts by using 0.18M tributyl phosphate. Whereas, in 1 to 2N nitric acid berkelium was not oxidized by cerium(IV). (auth)

30517 ACTINIDE CHEMISTRY IN SATURATED POTASSIUM FLUORIDE SOLUTION. Thalmayer, Conrad E.; Cohen, Donald (Argonne National Lab., Ill.). Advan. Chem. Ser., 71: 256-67 (1967).

From Symposium on Lanthanide/Actinide Chemistry, New York. See CONF-660962.

Absorption spectra were obtained for certain actinide ions that are soluble in saturated KF solution: U(IV), Np(IV), Np(V), Np(VI), and Am(III). Oxidation-reduction reactions of neptunium were studied. Four complex fluorides were prepared and identified by x-ray powder patterns: $\alpha-K_2NpF_6$, $\beta_1-K_2NpF_6$, $KNpO_2F_2$, and $K_3NpO_2F_5$. Three additional complex fluorides, of Np(III), Np(V), and U(VI), were prepared but not identified. (auth)

30518 ACTIVITY COEFFICIENTS OF LONG-CHAIN ALKYLAMMONIUM SALTS: EXTRACTANTS IN NON-POLAR SOLVENTS. Kertes, A. S.; Markovits, G. (Hebrew Univ., Jerusalem). pp 227-35 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

Vapor pressure lowering measurements on benzene, carbon tetrachloride and cyclohexane solutions of trilaurylamine chloride, bromide, nitrate, perchlorate and bisulfate have been carried out osmometrically. The data were analyzed in terms of activity coefficient of the solute in strictly binary systems via the Gibbs–Duhem relation. The variation of the activity coefficients is discussed in terms of molecular association of the solutes. (auth)

30519 ANIONIC ACETATO COMPLEXES OF THE HEXAVALENT ACTINIDES. ANION EXCHANGE AND AMINE EXTRACTION OF HEXAVALENT ACTINIDE ACETATES. Ryan, J. L.; Keder, W. E. (Battelle-Northwest Labs., Richland, Wash.). Contract AT(45-1)-1830. Advan. Chem. Ser., 71: 335-51(1967). (BNWL-SA-696).

From Symposium on Lanthanide/Actinide Chemistry, New York. See CONF-660962.

Spectrophotometric studies were used to identify the anionic hexavalent actinide acetate complexes present in aqueous and nonaqueous solutions, anion exchange resins, and amine extracts. The previously unreported tetraacetato complexes, $MO_2(C_2H_3O_2)_4^{2-}$, were identified in all these systems. The formation constant for the reaction $UO_2(C_2H_3O_2)_3^- + C_2H_3O_2^- \rightarrow UO_2(C_2H_3O_2)_4^{2-}$ in acetonitrile was found to be 2.0 ± 0.2. The ratio of tetraacetato to triacetato complex in anion exchange resins was found to be independent of aqueous acetate concentration but depended somewhat on aqueous acidity. The ratio of these species in amine extracts was almost independent of all variables except the ionizing power of the diluent used. The formation constant of the tetraacetato complex in the amine extract increases with decreasing dielectric constant of the diluent. (auth)

30520 AQUEOUS OXIDATION-REDUCTION REACTIONS OF URANIUM, NEPTUNIUM, PLUTONIUM, AND AMERICIUM. Newton, T. W.; Baker, F. B. (Los Alamos Scientific Lab., N. Mex.). Advan. Chem. Ser., 71: 268-95(1967).

From Symposium on Lanthanide/Actinide Chemistry, New York. See CONF-660962.

Experimental observations on actinide oxidation-reduction reactions are described and empirical results are tabulated. The rate laws were interpreted in terms of net activation processes, and these were tabulated together with the associated activation parameters—ΔF^*, ΔH^*, and ΔS^*. An electrical analog is described that was useful in interpreting complicated rate laws. Empirical correlations were found between the formal entropies of the activated complexes and their charges, and for sets of similar reactions, between the hydrogen ion dependence and ΔF^0, between ΔF^* and ΔF^0, and between ΔH^* and ΔH^0. The kinetic and physical evidence for binuclear species is discussed. (100 references). (auth)

30521 BULK VISCOSITY OF LIQUID D_2O. Jain, S. C.; Bhandari, R. C. (Univ. of Rajasthan, Jaipur, India). Chem. Phys. Lett., 2: 33-4(May 1968).

The bulk viscosity of heavy water (D_2O) was calculated from the two-state model and free-volume model of water and heavy water on the basis of Hall's theory of the absorption of ultrasonic waves and compared with the values obtained from the experimental values of the absorption coefficient. The two-state model was found to give a better agreement than the free-volume model. (auth)

30522 CATALYTIC REACTIONS INVOLVING AZOMETHINES. X. TRANSAMINATION OF 1-METHYL-4-FORMYLPYRIDINIUM IODIDE. Maley, John R.; Bruice, Thomas C. (Univ. of Califoornia, Santa Barbara). J. Amer. Chem. Soc., 90: 2843-7(May 22, 1968).

The reactions (H_2O solvent, 30°, in the absence of metal ions) of 1-methyl-4-formylpyridinium iodide (MPCHO) with glycine, alanine, glycine ethyl ester, 2-methylalanine, and β-alanine have been investigated. All the amino acids exhibited a rapid initial reaction; a second, slower reaction was then observed with glycine, alanine, and glycine ethyl ester but not with 2-methylalanine or β-alanine. The following characteristics were established for the second reaction: a deuterium isotope effect of 6.1 (comparing alanine and alanine-d_4); catalysis by alanine; and formation of pyruvate as the product. These results show the initial reaction to be aldimine formation and the second reaction to be a general base catalyzed conversion of aldimine to ketimine. MPCHO is thus capable of entering into a transamination reaction with α-amino acids. The second reaction (prototropy) produced a species absorbing in the visible region of the spectra (glycine 500 mμ and alanine 600 mμ), suggesting the formation of metastable dihydropyridine tautomeric structures of the intermediate carbanion zwitterion. The ability of MPCHO to enter into a transamination—whereas pyridine-4-aldehyde (PCHO) does not—is attributed to the greater electron withdrawal of the quaternized pyridine nitrogen. Though the nitrogen of PCHO may be protonated, it exists as the free base in the pH range where relatively strong general bases may be obtained at appreciable concentrations. The above results show that the catalytic effect of the 3-hydroxyl group of 3-hydroxypyridine-4-aldehyde is not essential to prototropy if the pyridine nitrogen carries a formal positive charge. (auth)

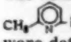
30523 COMPOSITION, CRYSTALLOGRAPHIC STRUCTURE, AND THERMAL STABILITY OF RARE EARTH URANATES.

Zubova, N. V.; Makarov, V. M.; Nikol'skii, V. D.; Petrov, P. N.; Teterin, E. G.; Chebotarev, N. T. Zh. Neorg. Khim., 13: 842-6(Mar. 1968). (In Russian).

The compounds formed in the system $R_2O_3-UO_3-H_2O$, where R is Pr, Nd, Sm, Y, or Sc, were synthesized at 270°C. The composition and structure were determined. The thermal stabilities of the synthesized compounds were investigated. The dependence of the composition and structure of the compounds on the size of the ion radius of the element of the Sc subgroup was examined. (tr-auth)

30524 COMPLEXES OF THE RARE EARTHS. N-SUBSTITUTED IMINODIACETIC ACIDS. Thompson, Larry C.; Shafer, Barbara L.; Edgar, John A.; Mannila, Kathleen D. (Univ. of Minnesota, Duluth). Advan. Chem. Ser., 71: 169-79(1967).

From Symposium on Lanthanide/Actinide Chemistry, New York. See CONF-660962.

The solution stabilities of rare earth complexes with N-methyliminodiacetic acid, N-benzyliminodiacetic acid, N-phenyliminodiacetic acid, N-methoxyethyliminodiacetic acid, and N-methylmercaptoethyliminodiacetic acid were measured at 25°C and $\mu = 0.1$ (KNO_3). The linear relationship between the pk values for the ionization of the ammonium proton and the log K_1 values for terdentate iminodiacetate ligands is demonstrated. This relationship is used to provide a measure of the free energy of formation of the third chelate ring in quadridentate iminodiacetates. The relative affinities of the HO–, CH_3O–, CH_3S–, , and  groups for the rare earth ions in this type of compound were determined. (auth)

30525 CONDENSED PHASE EQUILIBRIA IN THE MOLYBDENUM HEXAFLUORIDE–URANIUM HEXAFLUORIDE SYSTEM. Trevorrow, L. E. (Argonne National Lab., Ill.); Steindler, M. J.; Steidl, D. V.; Savage, J. T. Contract W-31-109-eng-38. Advan. Chem. Ser., 71: 308-19(1967).

From Symposium on Lanthanide/Actinide Chemistry, New York. See CONF-660962.

The temperature-composition phase diagram constructed from thermal arrests observed in the MoF_6-UF_6 system is characteristic of a binary system forming solid solutions, a minimum-melting mixture (22 mole % UF_6 at 13.7°C), and a solid-miscibility gap. The maximum solid solubility of MoF_6 in the UF_6 lattice is about 30 mole % MoF_6, whereas the maximum solid solubility of UF_6 in the MoF_6 lattice is 12 to 18 mole % UF_6. The temperature of the solid-state transformation of MoF_6 increases from ~–10°C in pure MoF_6 to ~–5°C in mixtures with UF_6, indicating that the solid solubility of UF_6 is greater in the low-temperature form of MoF_6 than in the high temperature form of MoF_6. This solid-solubility relationship is consistent with the crystal structures of the pure components: the low-temperature form of MoF_6 has an orthorhombic structure similar to that of UF_6. (auth)

30526 DEVELOPMENTS IN CHEMICAL THERMODYNAMICS OF THE LANTHANIDES. Westrum, Edgar F. Jr. (Univ. of Michigan, Ann Arbor). Advan. Chem. Ser., 71: 25-50(1967).

From Symposium on Lanthanide/Actinide Chemistry, New York. See CONF-660962.

The present status of thermochemical and thermal data for lanthanide metals, chalcogenides, borides, pnictides, and halides is examined and assessed. Many ambiguities occur concerning entropies, stabilities, and enthalpies of formation even of the oxides. Here, as in related compounds, magnetic and electronic phenomena, cooperative transitions, Schottky anomalies, and low-lying electronic levels make significant contributions to the thermal properties and are the motivation for further investigations. Schemes were devised to estimate the entropies associated with known but presently unmeasured transitions. Binary chalcogenides, halides, and oxygen-contaminated metals provided solid-state physicists with cryothermal anomalies, the temperatures of which often do not coincide with those of magnetic anomalies or (for impure metals) with transitions in sesquioxides. (203 references). (auth)

30527 DIFFERENT STATES IN THE SYSTEM WATER–CARBON. CASE OF POROUS GRAPHITE. Lang, Francois-Michel; Lafargue, Yves (CEN de Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. C, 266: 485-8(Feb. 19, 1968). (In French).

The adsorption of water on graphite (nuclear grade) at 25°C depends on the geometry of the sample. This is due to a capillary condensation on the surface. Inert gas pressure favoring this condensation produces the appearance of water–carbon linkages. The adsorption–desorption is totally reversible only up to 120°C. At higher temperatures a large proportion of the water is irreversibly fixed. (tr-auth)

30528 EFFECT OF PARTIAL DEUTERATION AND TEMPERATURE ON TRIPLET-STATE LIFETIMES. Lin, S. H. (Arizona State Univ., Tempe); Bersohn, R. J. Chem. Phys., 48: 2732-5(Mar. 15, 1968).

The lifetime of the triplet state of aromatic molecules increases when deuterons are substituted for its protons. For naphthalene, experiments showed that the decay rate is linear with the number of protons and independent of the position of substitution. This result is shown to follow from Lin's theory of nonradiative decay of excited states. (auth)

30529 EFFECT OF GAMMA IRRADIATION OF GADOLINIUM OXIDE ON THE HOMOMOLECULAR ISOTOPIC OXYGEN EXCHANGE REACTION. Sazonov, L. A.; Sokolovskii, V. D.; Boreskov, G. K.; Mitrofanova, G. N. Dokl. Akad. Nauk SSSR, 178: 1129-8(1968). (In Russian).

Since irradiation changes the type and number of defects in a solid, it can be used to investigate catalytic activity. Samples of Gd_2O_3 preliminarily heated in vacuum at 400°C for 6 hours were irradiated with ^{60}Co γ-radiation at doses of 4×10^5 to 1.8×10^7 R at liquid nitrogen temperatures. The irradiated samples were then transferred to a special low-temperature reactor where the oxygen exchange reaction was measured. The reaction rate constant for the oxygen exchange in units of (mole/cm^2 sec) $\times 10^{-12}$ is plotted as a function of reaction temperature and of irradiation dose. Experiments were run to estimate the rate of defect annealing. The energies of activation for defect annealing were found to be 0.14 and 0.17 kcal/mole at irradiation doses of 0.8 and 9.1×10^6 R. It is believed that the catalytically active centers formed during the irradiation are anion vacancies with captured electrons, that is, F-centers and their associations. (TTT)

30530 ELECTRONIC SPECTRA OF LANTHANIDE COMPOUNDS IN THE VAPOR PHASE. Gruen, D. M.; DeKock, C. W.; McBeth, R. L. (Argonne National Lab., Ill.). Advan. Chem. Ser., 71: 102-21(1967).

From Symposium on Lanthanide/Actinide Chemistry, New York. See CONF-660962.

The vapor phase spectra of the tribromides and triiodides of Pr, Nd, Er, and Tm and of the 2,2,6,6-tetramethyl-3,5-heptanedionates of Pr, Nd, Sm, Eu, Dy, Ho, Er, and Tm were measured in the range 4,000 to 30,000 cm. The transition intensities of most of the f — f transitions in the gaseous molecules are comparable with those found in crystal and solution spectra. The hypersensitive transitions obeying the selection rules $\Delta J = \pm 2$, $\Delta L \leq 2$, $\Delta S = 0$, are greatly enhanced, particularly in the gaseous halide molecules. This result led to reconsidering various intensity mechanisms. It appears that the vibronic mechanism can account for both the environmental sensitivity and the magnitude of the τ_2 parameter. The large oscillator strengths of the hypersensitive transitions in the vapor phase molecules can be rationalized in this manner. (auth)

30531 ELECTRONIC STRUCTURE OF THE ACTINIDE ELEMENTS. Fred, Mark (Argonne National Lab., Ill.). Advan. Chem. Ser., 71: 180-202(1967).

From Symposium on Lanthanide/Actinide Chemistry, New York. See CONF-660962.

The 5f, 6d, and 7s electrons of the elements from actinium to curium, all having about the same energy, produce many low levels. The spectra are complex, and analysis is complicated by the existence of two sets of low parent terms built on f^N and $f^{N-1}d$, having opposite parities and responsible for two almost independent sets of transitions. Within the past several years considerable progress has been made in the analysis with the aid of new data, especially Zeeman data, and the further help of theoretical predictions. It is now possible to describe the variation of binding energies of different types of electrons as a function of atomic number and degree of ionization, which can be correlated with chemical behavior. (auth)

30532 EUROPIUM CHELATES AS LASER MATERIALS. Ross, Daniel L.; Blanc, Joseph (RCA Labs., Princeton, N. J.). Advan. Chem. Ser., 71: 155-68(1967).

From Symposium on Lanthanide/Actinide Chemistry, New York. See CONF-660962.

A variety of lasers based on tetrakis β-diketonates of Eu^{3+} were developed over the last few years. A summary of the chemistry and energy transfer in these laser systems is presented, with particular attention to the salts of tetrakis benzoyltrifluoroacetone chelates of europium. Chemical effects attributed to solvents, benzene ring substitutions in the ligand, differing cations, and deuteration are considered. These effects manifest themselves most markedly in the variability of laser thresholds from compound to compound and solvent to solvent. The thresholds reflect association-dissociation equilibria, as well as energy transfer processes in the ligand and throughout the manifold of Eu^{3+} states. (38 references). (auth)

30533 ENHANCEMENT OF BIACETYL LUMINESCENCE BY DEUTERATION. Turro, Nicholas J.; Engel, Robert (Columbia Univ., New York). J. Amer. Chem. Soc., 90: 2989-90(May 22, 1968).

The effects of deuteration on radiationless processes, both internally and externally, were investigated. Data on the luminescence of $CH_3COCOCH_3$ (1-H) and $CD_3COCOCD_3$ (1-D) under various conditions are tabulated. Salient features of the data are the enhanced fluorescence and phosphorescence of 1-D over 1-H in C_6H_6 and the enhanced phosphorescence of both 1-H and 1-D in C_6D_6. The enhancement of fluorescence of 1-D or 1-H was corroborated by direct lifetime measurements of 0.05 M benzene solutions of 1-H ($\tau f = 10.0$ nsec) and 1-D ($\tau f = 11.7$ nsec). (P.C.H.)

30534 EXISTENCE OF DIVALENT CALIFORNIUM IN AQUEOUS SOLUTION. Cohen, L. H. (Institut voor Kernphysisch Onderzoek, Amsterdam); Aten, A. H. W.; Kooi, J. Inorg. Nucl. Chem. Lett., 4: 249-52(May 1968).

Since the chemical properties of Cf^{2+} were expected to be very similar to those of the divalent lanthanide ions Eu^{2+}, Yb^{2+}, and Sm^{2+}, and similar to those of Ba^{2+}, an attempt was made to separate the trivalent ions from the divalent ions by coprecipitation of the latter with sulphates Eu and Ba. An attempt was made to reduce Cf^{3+} ions in $EuCl_3$ by hydrogen at elevated temperatures (300 to 500°C) using $^{250+252}Cf$, ^{244}Cf, ^{244}Cm, and ^{153}Gd as tracers. $Eu(Cf)SO_4$ was then precipitated by Na_2SO_4 solution. Promising results were obtained. Successful attempts were made to reduce Cf^{3+} by means of Eu^{2+} in aqueous solution. Attempts were also made to reduce Cf^{3+} with Cr(II); this was not very successful. The data suggested a striking analogy between reduced Cf and some of the reduced rare earth ions (Yb^{2+} and Eu^{2+}) and also with Md^{2+}. It was concluded that there was good reason to assume that Cf was reduced to a considerable extent by these means, and that it can occur as a divalent ion in solution. (UK)

30535 ELECTROMETRIC INVESTIGATIONS OF URANYL ARSENITES. Saxena, R. S.; Prasad, Shiva; Mittal, M. L. (Malaviya Regional Engineering Coll., Jaipur, India). Monatsh. Chem., 99: 538-44(Mar.-Apr. 1968). (In German).

The stoichiometry of the compounds formed by the interaction of uranyl nitrate and different alkali arsenites (ortho-, pyro-, and meta-) have been investigated by means of pH and conductometric titrations. The breaks and inflections in titration curves provide cogent evidence for the formation of $3\ UO_2O \cdot As_2O_3$, $2\ UO_2O \cdot As_2O_3$, and $UO_2O \cdot As_2O_3$ in pH ranges 7.0 to 9.9, 6.0 to 7.5, and 5.0 to 6.8, respectively. The proportion of uranyl increases with the increase in the concentration of Na_2O molecules in alkali arsenites. The formation of uranyl arsenites is thus a function of H^+ ion concentration. The precipitation of these compounds has been found to be almost quantitative. (auth)

30536 ISOTOPE EFFECTS OF IODINE REACTIONS ACTIVATED BY THE RADIATIVE NEUTRON CAPTURE AND ISOMERIC-TRANSITION PROCESSES IN LIQUID HYDROCARBONS. Lambrecht, Richard M.; Rack, Edward P. (Univ. of Nebraska, Lincoln). Contract AT(11-1)-1617. J. Chem. Phys., 48: 3735-40(Apr. 15, 1968). (COO-1617-8).

The organic yields of $^{130}I + {}^{130m}I$ and ^{128}I activated by radiative neutron capture are compared to those of ^{130}I activated by isomeric transition. The organic yields of (n,γ)-activated $^{130m}I + {}^{130}I$ were consistently lower than the (IT) induced organic yields of ^{130}I and (n,γ)-activated ^{128}I. Radiogas chromatography analysis indicated the similarity of products, but differences in abundance of the relative product yields of ^{128}I, ^{130}I, and ^{82}Br. Similarities in yields and product distributions between iodine and bromine isomeric-transition-induced reactions may indicate that radiohalogens mainly trace their chemical environment. The autoradiation hypothesis appears to be the most satisfactory model to explain the chemical effects of nuclear transformations of halogen atoms in liquid hydrocarbon media. (auth)

30537 ISOTOPE EFFECT IN THE ^2H-NMR–SPECTRA OF PARTLY DEUTERATED HYDRATES. Pedersen, B.; Haland, K. (Sentralinstitutt for Industriell Forskning, Oslo). Chem. Phys. Lett., 2: 61-4(May 1968).

The quadrupole coupling constant, K, for the deuteron in the DHO-molecule was found to be about 1% larger than K in the D_2O-molecule in partly deuterated potassium oxalate monohydrate. It increased slightly with the temperature, and this increase is explained qualitatively as being due to the stretching of the hydrogen bond. (auth)

30538 FALL-OFF BEHAVIOUR AND KINETIC ISOTOPE-EFFECTS IN REACTIONS OF CYCLIC HYDROCARBONS. Lin, M. C.; Laidler, K. J. (Univ. of Ottawa). Trans. Faraday Soc., 64: 927-44(Apr. 1968).

The geometrical and structural isomerizations of cyclopropane and the decomposition of cyclobutane are considered from the standpoint of the RRKM theory. The fall-off curves depend critically on the high-pressure Arrhenius parameters the use of the latest values leads to good agreement with experiment in most cases. Whether or not a biradical mechanism is assumed, there is little effect on the calculated fall-off curves. The treatments are applied to isotope effects as functions of pressure and temperature. The activation energy difference $E_D - E_H$ varies with pressure in a complicated way, a conclusion that throws light on apparent discrepancies between the results of different workers. (auth) (UK)

30539 LANTHANIDE AND ACTINIDE ABSORPTION SPECTRA IN SOLUTION. Carnall, W. T.; Fields, P. R. (Argonne National Lab., Ill.). Advan. Chem. Ser., 71: 86-101(1967).

From Symposium on Lanthanide/Actinide Chemistry, New York. See CONF-660962.

Sets of theoretical energy levels were calculated for trivalent actinides and lanthanides and these levels correlated with transitions observed in the solution absorption spectra of these elements. Using the eigenvectors resulting from this energy level calculation, the theoretical matrix elements required to account for the observed band intensities in the two series of elements were computed. The extent to which the theoretical calculations can be correlated with experimental results is discussed, and some applications for the intensity relationships are pointed out. (auth)

30540 MEAN VIBRATION AMPLITUDES, THE BASTIANSEN–MORINO SHRINKAGE EFFECTS, AND THERMODYNAMIC VALUES OF SOME ISOTOPIC MOLECULES OF CARBON TRIOXIDE. Nagarajan, G.; Durig, James R. (Univ. of South Carolina, Columbia). Monatsh. Chem., 99: 473-83(Mar.-Apr. 1968). (In German).

Mean amplitudes of vibration for the bonded as well as nonbonded atom pairs and Bastiansen–Morino shrinkage effect for the isotopic species of carbon trioxide such as $^{12}C^{16}O_3$, $^{12}C^{18}O_3$, and $^{13}C^{16}O_3$ have been computed at the temperatures T = 298°K and T = 500°K by the group theoretical method employing the symmetry coordinates. Molar thermodynamic functions have also been calculated for the temperature range 200 to 2000°K on the basis of a rigid rotator, harmonic oscillator model. Results are briefly discussed. (auth)

30541 NEUTRON DIFFRACTION STUDY OF $ErPO_4$ AND $ErVO_4$. Patscheke, E. (Univ., Karlsruhe, Ger.); Fuess, H.; Will, G. Chem. Phys. Lett., 2: 47-50(May 1968).

The oxygen parameters x and z of $ErPO_4$ and $ErVO_4$ (I 4/amd) have been refined from neutron diffraction powder data by least squares analysis. The P–O and V–O distances in the PO_4^{3-} and VO_4^{3-} tetrahedra are 1.54 and 1.72 Å, respectively. The bonding mechanism in the tetrahedra is discussed. (auth)

30542 OCTAHEDRAL HEXAHALIDE COMPLEXES OF THE TRIVALENT ACTINIDES. Ryan, J. L. (Battelle Memorial Inst., Richland, Wash.). Contract AT(45-1)-1830. Advan. Chem. Ser., 71: 331-4(1967).

From Symposium on Lanthanide/Actinide Chemistry, New York. See CONF-660962.

The trivalent actinides, like the trivalent lanthanides, form only weak chloride complexes in aqueous solution, and although there is evidence of slight formation of anionic complexes in concentrated LiCl from anion exchange data, no anionic chloride complexes were previously positively identified. Ryan and Jørgensen recently prepared the trivalent lanthanide hexachloro and hexabromo complexes and studied their absorption spectra. Preliminary results of the extension of this work to the trivalent actinides are discussed. (auth)

30543 OPTICAL AND ELECTRON PARAMAGNETIC RESONANCE SPECTROSCOPY OF ACTINIDE IONS IN SINGLE CRYSTALS. Edelstein, N.; Easley, W.; McLaughlin, R. (Univ. of California, Berkeley). Advan. Chem. Ser., 71: 203-10(1967).

From Symposium on Lanthanide/Actinide Chemistry, New York. See CONF-660962.

The formation and stabilization of various oxidation states of actinide positive ions in CaF_2 crystals are described. Paramagnetic resonance and optical spectra are reported for divalent Am and trivalent Cm in these crystals. Tetravalent Cm and Pu, formed as a consequence of the intense alpha radiation, are identified by their optical spectra. (auth)

30544 OSCILLATOR MODEL OF THE UO_2^{2+} GROUP AND FLUORESCENT SPECTRA OF URANYL COMPOUNDS. Umreiko,

D. S.; Larkin, G. N. Zh. Prikl. Spektrosk., 8: 447-52(Mar. 1968). (In Russian).

The results confirming the accuracy of the oscillator representation of the UO_2^{2+} group in uranyl compounds are reported. (tr-auth)

30545 PHASE EQUILIBRIA IN THE SYSTEMS WATER–ETHANOL–HYDRAZINE MONOCHLORIDE AND DEUTERIUM OXIDE–ETHANOL–HYDRAZINE MONOCHLORIDE. Runtz, Gordon R.; Bain, Ralph L. (Univ. of Saskatchewan, Regina). J. Chem. Eng. Data, 13: 178-9(Apr. 1968).

The phase equilibria of the systems water–ethanol–hydrazine monochloride and deuterium oxide–ethanol–hydrazine monochloride were investigated as a function of temperature. No evidence for compound formation was found. (auth)

30546 PREPARATION AND CRYSTAL STRUCTURE OF SOME BERKELIUM COMPOUNDS. Cohen, D.; Fried~~, S.~~; Siegel, S.; Tani, B. (Argonne National Lab., Ill.). Inorg. Nucl. Chem. Lett., 4: 257-60(May 1968).

Studies are described on the preparation and crystal structure of $BkBr_3$, BkOBr, BkI_3, BkOI, and Bk_2S_3, employing ^{249}Bk. $BkBr_3$ was prepared by the action of gaseous HBr on Bk oxide at 800°C; it was produced as β- or orthorhombic modification, with cell dimensions $\underline{a}$ = 12.6 Å, $\underline{b}$ = 4.1 Å, c = 9.1 Å, space group Ccmm–D_{2h}^{17}, 4 molecules per cell. BkOBr was prepared by partial hydrolysis of $BkBr_3$; it showed tetragonal PbFCl-type structure, $\underline{a}$ = 3.95 Å, $\underline{c}$ = 8.1 Å. BkI_3 was formed by action of gaseous HI on Bk oxide at 650°C; $\underline{a}$ = 7.5 Å, c = 20.4 Å, space group R$\bar{3}$–C_3^2i. BkOI was formed as a non-volatile fraction in the preparation of BkI_3; its cell is tetragonal, with PbFCl structure; $\underline{a}$ = 4.0 Å, c = 7.5 Å. Bk_2S_3 was obtained by the action of a mixture of H_2S and CS_2 vapors on Bk oxide at 1100°C; cell dimensions for the cubic cell are $\underline{a}$ = 8.44 Å. (UK)

30547 POLAROGRAPHY IN PROPANEDIOL-1,2-CARBONATE. PART I. IONS OF ALKALI AND ALKALINE EARTH METALS. Gutmann, V.; Kogelnig, M.; Michlmayr, M. (Technische Hochschule, Vienna. Laboratorien der Ebenseer Solvay-Werke, Halle, Ger.). Monatsh. Chem., 99: 693-8(Mar.-Apr. 1968). (In German).

Polarographic investigations were carried out on alkali and alkaline earth metal ions, and on the ammonium ion, in propanediol-1,2-carbonate; the nature of the limiting currents, the diffusion current constants, the diffusion coefficients, the reversibility or irreversibility, and the half-wave potentials vs aqueous saturated calomel electrode, were determined in 0.1$\underline{M}$-solutions of tetraethylammonium perchlorate at 25.0°. Each of the ions investigated exhibited a well defined reduction wave with diffusion-controlled limiting current; the electrode reactions were reversible for Na^+, K^+, NH_4^+, Rb^+ Cs^+, Sr^{2+}, and Ba^{2+}, and irreversible for Li^+, Be^{2+}, Mg^{2+}, and Ca^{2+}. The simultaneous analytical determination of sodium and potassium as well as of calcium, strontium, and barium was possible. The influence of water up to 1% was negligibly small. (auth)

30548 SOLID-STATE CHEMISTRY OF AMERICIUM OXIDES. Keller, C. (Univ., Karlsruhe, Ger. Nuclear Research Centre, Karlsruhe, Ger.). Advan. Chem. Ser., 71: 228-47(1967).

From Symposium on Lanthanide/Actinide Chemistry, New York. See CONF-660962.

Ternary and polynary oxides of trivalent to hexavalent americium were obtained by solid-state reactions of Am_2O_3 and AmO_2 with oxides of various elements. Compounds of pentavalent and hexavalent americium are formed only with the oxides of alkali metals and alkaline earth metals. By reaction of AmO_2 with oxides of tetravalent elements—e.g., SiO_2, GeO_2, ZrO_2, HfO_2, or ThO_2—ternary oxides or oxide phases with tetravalent americium are stabilized. The solid-state reaction of AmO_2 with most group V elements yields compounds with trivalent americium that are isostructural with the analogous rare earth compounds. In the last types of reactions americium exhibits a typical actinide behavior. (auth)

30549 SPECTROPHOTOMETRIC STUDIES OF THORIUM COMPLEXING WITH ARSENAZO IV. Vasilenko, V. D.; Shanya, M. V. (Dnepropetrovsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol., 11: 138-41(1968). (In Russian).

Spectrophotometric studies of the reaction of thorium with Arsenazo IV showed that the components reacted in the ratio of Th : R = 1 : 3. The complex was amenable for photometric determination of thorium. The molecular extinction coefficient of the complex was equal to $(1.12 \pm 0.03) \times 10^5$ in 6 $\underline{N}$ hydrochloric acid at 660 nm. (R.V.J.)

30550 SOLVENT EFFECTS ON ISOTOPIC EXCHANGE REACTIONS. X. THE KINETICS AND MECHANISM OF IODINE EXCHANGE BETWEEN ELEMENTARY IODINE AND IODOPYRAZOLONE DERIVATIVES IN WATER. Koeroes, Endre; Orban, Miklos; Meszticzky, Aranka (Eoetvoes Lorand Tudomanyegyetem Szervetlen- es Analitikai-Kemiai Tanszeke, Budapest). Magy. Kem. Foly., 74: 103-6(Mar. 1968). (In Hungarian).

The iodine exchange reactions between elementary iodine and 1-phenyl-2,3-dimethyl-4-iodopyrazolone, and 1,2,3-trimethyl-4-iodopyrazolone were investigated in water. The rate of the exchange can be described by the expression $v = k[RI][I_2] + k_2[RI][I_2]^2$ (where RI denotes the organic iodo compound). Thermodynamic parameters ($\Delta H^\ddagger$, $\Delta S^\ddagger$, and $\Delta F^\ddagger$) of the exchange reactions were calculated. The probable mechanism of iodine exchange is given. (auth)

30551 STABILITY CONSTANTS OF PLUTONYL(VI) GLYCOLATES. Eberle, S. H.; Schaefer, J. B. (Kernforschungszentrum, Karlsruhe, Ger.). Inorg. Nucl. Chem. Lett., 4: 283-7(May 1968). (In German).

Pu(VI), like U, forms water-soluble complexes with glycolic acid. The reaction is accompanied by typical changes in the plutonyl ion absorption band at 8306 Å, such as always occur when the water molecules in the inner hydration sphere are displaced by other ligands. The absorption spectrum in the region of this line was studied as a function of pH in the presence of glycolic acid, and the composition and formation constants of the plutonium/glycolic acid complexes were deduced. (U.K.)

30552 THE TETRAVALENT COMPOUNDS OF PRASEODYMIUM. PART 5. THE FORMATION OF PRASEODYMIUM(IV) OXALATE BY THE THERMAL DECOMPOSITION OF PRASEODYMIUM(III) OXALATE IN AN OXYGEN ATMOSPHERE AND USE OF THIS EFFECT IN THE SEPARATION OF RARE EARTH METALS. Pajakoff, Sw. (Technische Hochschule, Vienna). Monatsh. Chem., 99: 484-500(Mar.-Apr. 1968). (In German).

In the thermal dissociation of praseodymium(III) oxalate under oxygen, praseodymium(IV) oxalate or praseodymium(IV) carbonate are being formed, which decompose at much lower temperature (310 to 330°C) than the oxalates of tervalent rare-earth elements (400°C). Cerium, built-in isomorphously in the lattice of the praseodymium oxalate catalyzes the oxidation process. The selective thermal decomposition of the oxalates of Ce, Pr, and Tb enables an effective separation of these elements from the other rare earth elements by extraction with complex forming solutions, followed by precipitation from these solutions. (auth)

30553 THE CHARACTERIZATION OF HIGH-TEMPERATURE VAPORS. Margrave, John L. (ed.). New York, John Wiley and Sons, Inc., 1967. 564p. $24.95.

Information is presented on the following topics: vapor pressure measurements; structures and thermodynamic properties of high-temperature species; and kinetic aspects of evaporation and sublimation processes. Data on vapor pressure for the elements, volatilities of refractory inorganic compounds, and transmission probabilities and recoil force correction factors for conical orifices are appended. (P.C.H.)

30554 THERMODYNAMIC PARAMETERS OF FLUORIDE COMPLEXES OF THE LANTHANIDES. Walker, Jeffrey B.; Choppin, Gregory R. (Florida State Univ., Tallahassee). Contract AT(40-1)-1797. Advan. Chem. Ser., 71: 127-40(1967).

From Symposium on Lanthanide/Actinide Chemistry, New York. See CONF-660962.

Solvent extraction, potentiometry, and calorimetry were used to determine the thermodynamic parameters of the formation of the monofluoride complex of trivalent lanthanide ions at 25°C and an ionic strength of 1$\underline{M}$ ($NaClO_4$). The enthalpies were all endothermic, ranging from 4.0 to 9.5 kcal/mole; consequently, the large, positive entropies ranging from 25 to 48 cal/°C/mole explain the high stability constants. This large entropy results from the decrease in overall water structure when the fluoride ion is complexed. The difference in the enthalpies of formation of LnF^{2+} and $LnAc^{2+}$ can possibly be explained by a difference in covalence for Ln–F and Ln–O bonds. (auth)

30555 TETRA- AND PENTAVALENT ACTINIDE FLUORIDE COMPLEXES. PROTACTINIUM TO CURIUM. Penneman, Robert A.; Keenan, Thomas K.; Asprey, Larned B. (Los Alamos Scientific Lab., N. Mex.). Advan. Chem. Ser., 71: 248-55(1967).

From Symposium on Lanthanide/Actinide Chemistry, New York. See CONF-660962.

X-ray data are given for tetragonal $LiF \cdot XF_4$ and for rhombohedral $7NaF \cdot 6XF_4$, X = Th, Pa, U, Np, Pu, Am, and Cm. Hydrogen reduction of alkali fluoride-Pa(V) fluoride complexes yields $LiF \cdot PaF_4$ and $7MF \cdot 6PaF_4$ (where M = Na, K, Rb). When $3NaF \cdot PaF_5$ is treated with H_2 at 450°C its absorption spectrum shows Pa(IV) to be present but its x-ray structure is not changed. Pentavalent compounds include $MF \cdot PaF_5$, $MF \cdot UF_5$ (M = Li through

Cs), as well as $CsF \cdot NpF_5$, $CsF \cdot PuF_5$, $2RbF \cdot NpF_5$, $2RbF \cdot PuF_5$, and $3RbF \cdot PaF_5$. Fluorination of UF_4 in liquid anhydrous HF yields UF_5. When alkali fluoride and UF_4 are present in liquid HF, fluorination forms blue, soluble UF_6^-. Fluorine oxidation of NpF_4 in a melt of $CsF \cdot 2HF$ yields magenta colored NpF_6^-. (auth)

30556 THEORY OF DEUTERIUM EFFECT ON THE ESR SPECTRA OF CYCLIC POLYENE RADICALS: A SEMIEMPIRICAL APPROACH. **Rossi, M.; Nordio, P. L.; Giacometti, G. (Univ. of Padua). Theor. Chim. Acta, 10: 263-8(Apr. 2, 1968).**

The effect of substituting one hydrogen atom with a deuterium atom on the spin density distribution of cyclic aromatic mononegative ions was theoretically investigated. Vibronic interaction with CH modes is considered and evaluated on the basis of a semiempirical approach which makes use of experimental ir results. The predictions are consistent with the available experimental data. (auth)

30557 THE CRYSTAL STRUCTURE OF W_2C. **Yvon, K.; Nowotny, H.; Benesovsky, F. (Univ., Vienna. Metallwerk Plansee, A. G., Reutte/Tirol, Austria). Monatsh. Chem., 99: 726-9(Mar.-Apr. 1968). (In German).**

An orthorhombic modification of W_2C, β-W_2C, was prepared. X-ray studies of the compound showed some pseudohexagonal reflections, and the lattice parameters were: a = 4.728, b = 6.009, and c = 5.193 Å. Neutron diffraction studies of α-W_2C showed a hexagonal phase with anti-CdI_2 structure. Structures of other phases are also discussed. (M.C.G.)

30558 URANIUM TETRACHLORIDE–ALUMINIUM TRICHLORIDE VAPOR COMPLEX. **Gruen, D. M.; McBeth, R. L. (Argonne National Lab., Ill.). Inorg. Nucl. Chem. Lett., 4: 299-303(May 1968).**

The studies described led to the spectroscopic identification of a volatile UCl_4–$Al\ Cl_3$ complex, and it appears that $AlCl_3$ is capable of forming gaseous complexes with metal chlorides widely distributed throughout the periodic table. The preparative and spectrophotometric techniques employed are described. The electronic absorption spectrum of the vapor complex in the range 4,000 to 25,000 cm^{-1} is shown, together with partial pressure curves. The ratio $P_{complex}/P_{UCl_4}$ was $\cong 10^4$ at 350°C. (UK)

30559 URANYL METABORATE AND SODIUM URANYL BORATE. **Hoekstra, Henry R. (Argonne National Lab., Ill.). Advan. Chem. Ser., 71: 320-30(1967).**

From Symposium on Lanthanide/Actinide Chemistry, New York. See CONF-660962.

Uranyl metaborate, $UO_2(BO_2)_2$, is prepared by heating U_3O_8 with an excess of boric oxide in air at 900 to 1100°C. In the presence of excess B_2O_3 the salt is thermally stable to 1100°C in air and to ~950°C in a nitrogen atmosphere. Without excess B_2O_3, decomposition begins at 750°C in air. The greenish-yellow crystals of $UO_2(BO_2)_2$ are insoluble in water but hydrolyze slowly to $UO_2(OH)_2 \cdot H_2O$. The crystal symmetry is believed to be monoclinic. The infrared spectrum of $UO_2(BO_2)_2$ is compared with spectra of ring-type ($NaBO_2$) and chain-type (CaB_2O_4) metaborates. The synthesis of several alkali uranyl borates (MUO_2BO_3) is described, and the infrared spectrum of the sodium salt is analyzed with the aid of a borate preparation enriched in ^{10}B. (auth)

30560 VOLATILE RARE EARTH CHELATES OF β-DIKETONES. **Sievers, Robert E. (Aerospace Research Labs., Wright-Patterson AFB, Ohio); Eisentraut, Kent J.; Springer, Charles S. Jr.; Meek, Devon W. Advan. Chem. Ser., 71: 141-54(1967).**

From Symposium on Lanthanide/Actinide Chemistry, New York. See CONF-660962.

A number of volatile rare earth chelates containing the ligands, 1,1,1,2,2,3,3-heptafluoro-7,7-dimethyl-4,6-octanedione, [H(fod)], and 2,2,6,6-tetramethyl-3,5-heptanedione, [H(thd)] were synthesized and investigated. The fod complexes are more volatile than other known compounds of the lanthanide elements. The fod complex of Sc(III) and the lanthanide thd compounds are anhydrous. The fod chelates of Y(III) and the lanthanides are isolated as hydrates but can easily be dehydrated in vacuo over P_4O_{10}. Gas chromatographic and thermogravimetric data reveal that the volatilities of the complexes increase as the ionic radii of the metal ions become smaller. (auth)

30561 LANTHANIDE/ACTINIDE CHEMISTRY. **Symposium, 152nd Meeting of the American Chemical Society, New York, N. Y., September 13-14, 1966. Advances in Chemistry Series. Volume 71. Washington, D. C., American Chemical Society, 1967. 369p. $11.00. (CONF-660962).**

Separate abstracts were prepared for each of the 25 papers. (M.C.G.)

For abstracts of individual papers see: *30468, 30514, 30516, 30517, 30519 30520, 30524–30526, 30530–30532, 30539, 30542, 30543, 30548, 30554, 30555, 30559, 30560, 30622, 31454, **and** 31995–31997.*

30562 ISOTOPE EFFECT FOR DIFFUSION OF IRON IN VANADIUM. **Coleman, Michael Garm. Urbana, Ill., Univ. of Illinois, 1967. 36p.**

Thesis.

The diffusion cofficients of iron, using ^{59}Fe as the radioactive tracer, and the isotope effect parameter, using ^{55}Fe and ^{59}Fe as tracers, were measured in V over a temperature range of more than 800°C by standard sectioning and counting techniques. Vanadium is one of several body-centered cubic metals that show "anomalous" diffusional behavior. The diffusion of ^{59}Fe in V exhibits two straight lines on a ln D versus 1/T plot, with a change of slope occurring near 1350°C. The two straight line portions of this plot can be expressed directly as $D = 274.(\pm 15.) \exp(-92170.(\pm 105.)/RT)$ at high temperatures and by $D = 0.373 (\pm 0.051) \exp(-71000.(\pm 180.)/RT)$ at low temperatures. These data can also be analyzed as the sum of two exponentials. The isotope effect parameter is a parameter sensitive to a change of mechanism of diffusion. The values of this parameter measured in this work are approximately constant at low temperatures but decrease rapidly with temperature above 1350°C. The diffusion coefficient measurements and the isotope effect parameter measurements conclusively indicate that two mechanisms of diffusion operate in vanadium. The mechanism predominant at low temperatures is identified as motion of a single vacancy, and the mechanism predominant at high temperatures is quite probably motion of divacancies. It is also inferred that the diffusional behavior of other "anomalous" body-centered cubic metals can be explained in this manner. (Disser. Abstr.)

30563 NUCLEAR MAGNETIC RESONANCE STUDIES OF HYDROGEN–DEUTERIUM EXCHANGE IN POLYCARBOXYLICAMINO ACID CHELATES AND LIGANDS. **Terrill, James Barbour. Chapel Hill, N. C., Univ. of North Carolina, 1967. 127p.**

Thesis.

The isotopic exchange in acidic heavy water of cobalt(III) polyaminocarboxylic acid chelates containing glycinate ring structures was followed by nuclear magnetic resonance spectroscopy (NMR) by observing decreases in spectral intensities. The exchange process, occurring by pseudo-first-order decay, was studied in the acidity range 0.05 $\underline{M}$ to 0.5 $\underline{M}$ acid at 85, 95, and 103°C. Intermediate isotopic enantiomeric species were observed to be formed at the out-of-plane methylene carbon, while the in-plane methylene protons did not undergo direct isotopic exchange. A major consideration in elucidating various features of the exchange process was the stereochemistry of the individual ligand. An enol intermediate has been proposed for the exchange mechanism. The hydrogen-deuterium exchange in alkaline heavy-water solutions at 95°C of bivalent metal-ethylenediaminetetraacetates (denoted EDTA) was followed with NMR spectroscopy by observing decreases in spectral intensities. The exchange process studied in 0.1 $\underline{M}$ to 0.8 $\underline{M}$ OD^- was first order in complex and first order in OD^-. The order of reactivity of the metal chelates, $Cu^{2+} > Ni^{2+} > Co^{2+} > Zn^{2+} > Pb^{2+} > Cd^{2+} > Mg^{2+} > Ca^{2+} > Sr^{2+} > Ba^{2+}$, correlates well with the strength of the metal-ligand bonds. Only the acetate methylene protons exchange at a measurable rate. Mixed hydroxyl complexes which form in Zn, Cd, Cu, and Co–EDTA systems had a somewhat slower rate of isotopic exchange. Structures for the mixed hydroxyl complexes have been proposed on the basis of the magnitude of change in the rate of hydrogen-deuterium exchange accruing from a change in metal-ligand bonding. The hydrogen-deuterium exchange in heated heavy water solutions of unassociated polycarboxylicamino acids has been investigated using NMR techniques. Model compounds were utilized to provide a spectrum of insight into the NMR observations. The exchange rate of acetate methylene protons (the only type of exchange occurring at a measurable rate) which had a primary neighboring nitrogen, glycine, showed a first order dependence on the deuteroxide concentration. A classical carbanion intermediate has been proposed for this process. On the other hand, the exchange rate of acetate methylene protons with a tertiary neighboring nitrogen, N,N-dimethylglycine, was observed to be independent of the deuteroxide concentration. A two proton transfer mechanism in which the first step is a pre-equilibrium step has been proposed for this process. Furthermore, structures have been proposed for the sodium and lithium complexes of EDTA and nitrilotriacetate on the basis of hydrogen-deuterium exchange observations. Unfortunately, the results of the hydrogen-deuterium exchange experiments in the case of the monoprotonated EDTA species were not fruitful in obtaining additional insight into the proper representation of this hydrogen-bonded molecule. The results are anticipated to be most helpful toward the development of useful analytical procedures. (Disser. Abstr.)

30564 URANIUM OXIDE SOLS. Hurley, Forrest R.; Tecotzky, Melvin; Vanik, Milton Charles U. S. Patent 3,375,203. June 20, 1966.

A method is described for the preparation of a stable aqueous UO_2 sol made up of a homogeneous dispersion in water of spheroidal particles having a particle size in the range from 60 to 1900 Å. The pH of the dispersion is in the range from 1.0 to 5.0 and the specific conductivity is between 10^{-5} and 10^{-2} mho. The sol has the fluorite crystal structure up to at least 150°C. The sol particles may be coated with a layer of silica about 30 to 120 Å thick, and the sol must be stabilized in solution by raising the pH to 7.0 to 10.0. (B.L.M.)

30565 ACID PROPERTY OF WATER OF HYDRATION IN SOME SALT SOLUTIONS. Vdovenko, V. M.; Statsevich, V. P.; Suglobova, I. G.; Suglobov, D. N. Radiokhimiya, 10: 6-12 (1968). (In Russian).

As a measurement of the acid properties of the water of hydration, a displacement of the frequency, $\nu_{C=O}$, of the solvent (ethyl acetate), arising during formation of the hydrogen bonds of H_2O–solvent was used. $\Delta\nu^{H_2O}_{C=O}$ was measured for solutions of uranyl and thorium hydrate salts and a series of other salts. $\Delta\nu^{H_2O}_{C=O}$ increased with the increase of the stability of the donor-acceptor bond of the metal ions with water and with reduction of the coordination number of the central ion and basicity of the adjacent ligands of the water molecule in the coordination medium. Evaluations were made of the positive charge on the protons of the water of hydration and the energy of the hydrogen bond of the water of hydration with ethyl acetate. The proton donor properties of the water of hydration were compared with the analogous properties of organic acids. (tr-auth)

30566 ADSORPTION OF URANIUM BY ION EXCHANGE RESINS IN THE PRESENCE OF FERRICYANIDE. Tataru, S.; Filip, Gh.; David, B. (Recherches Technologiques pour les Metaux Rares, Bucharest). Rev. Roum. Chim., 13: 429-36 (Apr. 1968). (In French).

Studies were made on the effects of potassium ferricyanide on the adsorption of uranium by low-strength ion exchange resins from alkaline solutions obtained after lixiviation of uraniferous minerals with the aid of sodium carbonate. The results showed that the ferricyanide ion has a negative influence on the adsorption of uranium in replacing it in the structure of the ion exchange resins which have adsorbed it. (tr-auth)

30567 DETERMINATION OF THE SIZE OF THE CHARGE OF COMPLEX ANIONS BY THE ION EXCHANGE METHOD. Grinberg, A. A.; Petrzhak, G. I.; Stepanova, L. N. Radiokhimiya, 10: 96-8 (1968). (In Russian).

The possibility of using ion exchange for the determination of the charge of complex ions by means of anion exchange layers with different swelling capacity was studied. It was established that the complex anions of potassium uranium tetraoxalate $K_4[U(C_2O_4)_4]\cdot 5H_2O$ in potassium oxalate solution has a charge practically equal to four. (tr-auth)

30568 KILOGRAM-SCALE PRODUCTION OF PLUTONIUM HEXAFLUORIDE BY FLUORINATION IN A FLUIDIZED BED. Levitz, N. M.; Vogel, G. J.; Carls, E. L.; Grosvenor, D.; Kullen, B.; Raue, D.; Murphy, W. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 35-6(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30569 OXIDATION OF U_4O_9 AT TEMPERATURES BELOW 300°C. Kuz'micheva, E. U.; Kovba, L. M.; Ippolitova, E. A. Radiokhimiya, 10: 105-9(1968). (In Russian).

The oxidation of U_4O_9 proceeds somewhat differently from the oxidation of uranium dioxide (the α-U_3O_7 phase is not formed). During oxidation of U_4O_9, aside from the earlier reported tetragonal oxides β-U_3O_7 and γ-U_3O_7, the formation of the rhombic phase δ-U_3O_7 is established. The structure of this phase is close to that of the tetragonal oxide. (tr-auth)

30570 PAPER CHROMATOGRAPHY OF INORGANIC SUBSTANCES. VIII. HYDROFLUORIC ACID–HYDROCHLORIC ACID SOLVENTS. Popa, G. (Univ., Bucharest); Nascutiu, T.; Iliescu, V. Rev. Roum. Chim., 13: 447-54(Apr. 1968).

For determining the possibilities of separation of greater groups of inorganic ions in hydrofluoric media the behavior of 60 ions in mixtures consisting of organic solvents, 40% HF and 6 or 10N HCl in different ratios was studied. As organic solvents ethyl-, isopropyl-, a-butyl-, or isopentyl alcohols as well as methyl ethyl ketone and methyl n-propyl ketone were used. Some of the studied solvents gave good separations of the elements of ammonium and hydrogen sulfide group. (auth)

30571 REACTION OF ZIRCONIUM AND HAFNIUM MIXTURES WITH THALLIUM OXIDES AT 1000°C. Plyushchev, V. E.; Kushakovskii, V. I.; Zhidkov, B. A.; Trenin, L. I.; Rozdin, I. A. (Moscow Inst. of Fine Chemical Tech.). Izv. Akad. Nauk SSSR, Neorg. Mater., 4: 738-44(May 1968). (In Russian).

A pyrochemical method was developed for production of thallium(III) oxide from thallium(I) nitrate. Thermal and x-ray analyses were made of thallium oxide properties at 900°C. Combined precipitation of Zr and Hf hydroxides with thallium(III) hydroxide showed that at 1000°C the reaction of the components does not form chemical compounds or solid solutions. (tr-auth)

30572 SPECTROPHOTOMETRIC STUDY OF THE REACTION OF THE URANYL ION WITH DERIVATIVES OF PYRIMIDINE. Popea, Florica; Parlog, Constanta (Centre of Inorganic Chemistry, Bucharest). Rev. Roum. Chim., 13: 473-83(Apr. 1968).

By means of spectrophotometric methods (Job's continuous variation method, molar ratio method, slope ratio method, logarithmic plot method, and straight lines method) the following compounds were evidenced in solution: ML = 1/1 in the uranyl-thiobarbituric acid system in methanol and ethanol, ML′ = 1/1 in the uranyl-barbituric acid system in aqueous solution, and ML′ = 1/2 in the uranyl-barbituric acid system in ethanol. The dissociation constants of the compounds are of the 10^{-6}, 10^{-4}, and 10^{-11} order of magnitude, respectively. The reaction of the uranyl ion with the thiobarbituric acid in ethanol could be applied for the determination of uranium(VI) in some ores. Cerium, thorium, zirconium, and alkaline metals must be absent. (auth)

30573 STUDIES OF METAL NITRATES IN MIXTURES OF SOLVENTS. I. THE SYSTEMS: URANYL NITRATE HEXAHYDRATE–ACETONE–CARBON TETRACHLORIDE; URANYL NITRATE DIHYDRATE–ACETONE–CARBON TETRACHLORIDE. Ripan, Raluca; Eger, I.; Bojan, N. (Institut de Chimie de l'Academie, Cluj). Rev. Roum. Chim., 13: 421-4(Apr. 1968). (In French).

The solubility of both uranyl nitrate hexahydrate and uranyl nitrate dihydrate was studied in a mixture of acetone–carbon tetrachloride at 25°, the total amounts of the solvents being maintained constant. An increase of the amount of acetone in the mixture increased the solubility of the uranyl nitrate. After having reached a certain concentration of salt, the solvents separated into distinct phases. This separation is a consequence of an interaction of the salt with the solvents. The limits of solubility of the hydrated uranyl nitrates at which the mixture of solvents again became homogeneous was determined. It was noted that uranyl nitrate dihydrate has a higher solubility than uranyl nitrate hexahydrate regardless of the composition of the mixed solvents. (tr-auth)

30574 ISOTOPE EXCHANGE OF BROMINE IN SOME BROMAMMINATES OF TETRAVALENT PLATINUM. Grinberg, A. A.; Kukushkin, Yu. N.; B'yugina, A. F. Radiokhimiya, 10: 46-50 (1968). (In Russian).

The isotope exchange of bromine in ions of trans-$[Pt(NH_3)_4Br_2]^{2+}$ proceeds by the R-K$[Pt(NH_3)_4Br_2]^{2+}[Br^-]$ velocity rule. At 25° the rate constant is in the limits from 1.1 to 2.6 l/mole/sec. The proposed mechanism for the isotope exchange of bromine in the ions of trans-$[Pt(NH_3)_4Br_2]^{2+}$ includes the redox process. (tr-auth)

30575 CHEMICAL THERMODYNAMICS OF COMPLEX COATINGS ON METALS. Ruzinov, L. P.; Dubinin, G. N.; Glubokova, T. N.; Veselaya, G. N. (State Inst. of Rare Metals, Moscow. Moscow Inst. of Aviation). Izv. Akad. Nauk SSSR, Neorg. Mater., 4: 711-13(May 1968). (In Russian).

Chemical thermodynamics of surface alloying of Fe, Ni, Al, W, Nb, Re, Mo, and Ta by gaseous precipitation of two elements (Al–Cr, Ti–B, C–Cr, Ti–C, Hf–B, Zr–B, Si–Mo, Si–W, Si–Nb, and Si–W) were studied. A calculation method is suggested for determining the amount of gaseous salt concentration on the treated surfaces. (R.V.J.)

30576 INVESTIGATION OF THE FORMATION OF THE COMPLEX OF PROTACTINIUM WITH ACETYL ACETONE IN PERCHLORIC ACID SOLUTION. D'yachkova, R. A.; Khlbnikov, V. P.; Spitsyn, Vikt. I. Radiokhimiya, 10: 21-6(1968). (In Russian).

The extraction of protactinium with solutions of acetyl acetone in benzene from perchloric acid solutions at $\mu = 1$ was investigated. On the basis of the study of the dependence of K_1 of Pa on $[H^+]$, $[A^-]$, and [HA] it was established that Pa is extracted in the form of complexes of the composition $MA_2(HA)_2$, and in the aqueous phase the compounds MA^+ and MA_2 are formed, where M^{2+} is the doubly charged hydrolyzed ion of Pa. The stability constants of the complexes MA^+ and MA_2 were calculated as $\beta_1 = 6.8 \times 10^8$, $\beta_2 = 2.5 \times 10^{16}$ (by the two-parameter method); $\beta_1 = 9.2 \times 10^8$, $\beta_2 = 2.7 \times 10^{16}$ (by the Bjerrum method). A mechanism for the extraction reaction of Pa with acetylacetone was proposed: $M^{2+} + 4HA \rightleftharpoons MA_2(HA)_{2_0} + 2H^+$. The constant of this reaction was calculated as K = 1.79 ± 0.31. (tr-auth)

30577 INVESTIGATION OF THE COMPLEX FORMATION OF Ce(III) WITH HEXAMETHYLENEDIAMINETETRAACETIC ACID. Lebedev, I. A.; Shalinets, A. B.; Yakovlev, G. N. Radiokhimiya, 10: 98-102(1968). (In Russian).

The electromigration process was used to study the formation of the complex of Ce^{3+} with hexamethylenediaminetetraacetic acid (6-MDTA). The results showed that 6-MDTA can form polynuclear (at $|M|_{tot} > 5 \times 10^{-6}\underline{M}$) and mononuclear complex forms, the number of which, in comparison with EDTA, is large. (J.S.R.)

30578 INVESTIGATION OF THE FORMATION OF COMPLEXES OF AMERCIUM, CURIUM, CERIUM, AND PROMETHIUM WITH DIETHYLENETRIAMINEPENTAACETIC ACID. Lebedev, I. A.; Filimonov, V. T.; Shalinets, A. B.; Yakovlev, G. N. Radiokhimiya, 10: 93-6(1968). (In Russian).

By distribution and electromigration methods, the complex formation of trivalent Am, Cm, Ce, and Pm with [(carboxymethylimino)bis(ethylenenitrilo)] tetraacetic acid (H_5A) was investigated at pH = 1 to 2.5 and H_5A concentration of $1 \times 10^{-3}\underline{M}$. It was established that under the conditions given, complex ions of the composition MA^{2-} and MHA^- are formed. Their stability constants were calculated. (tr-auth)

30579 NOBELIUM: TRACER CHEMISTRY OF THE DIVALENT AND TRIVALENT IONS. Maly, Jaromir; Sikkeland, Torbjorn; Silva, Robert; Ghiorso, Albert (Univ. of California, Berkeley). Science, 160: 1114-15(June 7, 1968).

In the absence of oxidizing or reducing agents the chromatographic and coprecipitation behavior of element 102 is similar to that of the alkaline earth elements. After oxidation with ceric ions, the behavior is that expected of a trivalent actinide. Nobelium is the first actinide for which the 2+ oxidation state is the most stable species in aqueous solution. (auth)

30580 THE QUESTION OF THE COMPLEX FORMATION OF U(VI) AND Np(IV) WITH HYDROGEN PEROXIDE AND OF Np(IV) IN OXALATE SOLUTIONS. Moskvin, A. I. Radiokhimiya, 10: 13-21(1968). (In Russian).

The composition and stability constants of the peroxide complexes $UO_2O_2^0$ and $UO_2(O_2)_2^{2-}$ were determined. The values of the constant were $\beta_1 = 1.1 \times 10^{23}$ and $\beta_2 = 1.4 \times 10^{60}$ ($\mu \simeq 0$), respectively. It was found that the magnitude of the solubility product of uranyl peroxide is 3.3×10^{-38}. It was established that the dissolution processes of the peroxide of Np^{IV} in mixed solutions of $HNO_3-H_2O_2$ of different concentration proceeds basically with the formation of the complexes $Np(H_2O_2)^{4+}$, $Np(O_2)_{1.15}(H_2O_2)^{2+}$, $Np(O_2)_{2.3}(H_2O_2)^0$, and $Np(O_2)_{2.7}(H_2O_2)^{1.4-}$. For complexes with the ratio O_2^{2-}/Np^{4+} equal to 3.3 and 3.7, the stability constants calculated were $\log \beta_{2.3-0.0} = 84.9$ and $\log \beta_{2.7-0.0} \cong 111$. The solubility product of the peroxide of $Np^{(IV)}$ was determined to be 6×10^{-80}. The scheme for the dissolution processes of $Np(C_2O_4)_2 \cdot 6H_2O$ in the $HNO_3-H_2C_2O_4$ system is given, and the composition and stability constants of the oxalate complex of Np^{4+} were determined. (tr-auth)

30581 TETRAFTORID URANA. (Uranium Tetrafluoride). Gagarinskii, Yurii Vladimirovich; Khripin, Lev Aleksandrovich. Moscow, Atomizdat, 1966. 230p.

Results of a study of UF_4 properties are presented and a critical review offered of available data on the physical and chemical properties of UF_4, its crystal hydrates and double salts. Principal attention is given to thermodynamic data. Methods of obtaining these compounds are summarized. The crystal structure of UF_4 is described. An analysis is made of the chemical bond in UF_4 and of the nature of its crystal hydrates and the products of their dehydration. Binary and ternary systems, formed from UF_4 with other halides, are described and the phase diagrams of these systems are given. (ATD)

Radiation and Nuclear Chemistry

Refer also to abstracts 30529, 30536, 30579, 31531, 32006, 32007, and 32010.

30582 (AAEC/TM-422) THE PREPARATION OF m- AND p-HYDROXY-BENZOIC ACIDS (^{14}C CARBOXYL) BY RADIOLYSIS OF AN AQUEOUS SOLUTION OF BENZOIC ACID (^{14}C CARBOXYL). Davison, A. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jan. 1968. 9p. Dep.

(^{14}C carboxyl) $\underline{m}$-hydroxybenzoic acid is not available commercially. It was synthesized in low yield by radiolysis of an oxygenated aqueous solution of (^{14}C carboxyl) benzoic acid, and was separated from unchanged benzoic acid on a cellulose column, and from other radiolytic products by thin-layer chromatography. The para isomer was recovered in the same process. The radiochemical purity of the products was checked using a paper chromatographic separation. (auth)

30583 (AAEC/TM-428) HEAVY WATER REACTOR CHEMISTRY STUDIES. PART 2. THE ANALYSIS OF EXHAUSTED HIFAR ION-EXCHANGE RESINS. Ryan, Helen F.; Smythe, L. E. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jan. 1968. 18p. Dep.

Four batches of exhausted HIFAR ion-exchange resins were analyzed to obtain information on the nature of impurities in the system and on corrosion and radiation degradation of the resins. The life of the ion exchanger was found to be governed by the carbon dioxide in the circuit, the major source of which was the radiation degradation of the resins. Methods for prolonging the life of the HIFAR ion exchanger were considered. (auth)

30584 (COO-1088-30) THE RADIATION CHEMISTRY OF HIGH POLYMERS. Technical Report No. 13, April 1, 1967–April 1, 1968. Dole, Malcolm (Northwestern Univ., Evanston, Ill. Dept. of Chemistry). May 1, 1968. Contract AT(11-1)-1088. 16p. Dep. CFSTI.

Developments are reported for studies on: use of ESR spectra in the assignment of the uv absorption bands to specific absorbing groups; power saturation of ESR spectra; extinction coefficient of the allyl free radical; comparison of the decay at elevated temperatures of the allyl, dienyl, and trienyl free radicals; use of uv spectroscopy for measurement of diene formation in liquid polyethylene; new absorption maximum for irradiations in the molten state; theory of free radical transformations; and measurement of exothermic heats of reaction resulting from free radical recombination. (P.C.H.)

30585 (COO-1728-1) CHEMICAL CONSEQUENCES OF THE AUGER EFFECT IN THYROXINE AND ITS ANALOGUES. Technical Progress Report. Diehn, Bodo (Toledo Univ., Ohio). May 15, 1968. Contract AT(11-1)-1728. 9p. Dep. CFSTI.

Initial studies were designed to show whether there is any chemical effect due to resonance absorption of x rays in the iodine. A marked release of iodine was observed in the first irradiations of thyroxine. Studies on 3,5-diiodothyronine and thyroxine showed that the 3,5-diiodothyronine is much more sensitive to radiation than thyroxine. The value for G_{I_2} seemed to depend on E_{max} in both cases. This may be due to a dose effect and/or differences in Auger yields associated with the K- and L-shell electron vacancies. (M.C.G.)

30586 (EUR-3914(Pt.2)) HIGH DOSE INTEGRATING CHEMICAL DOSIMETERS. THE RADIOLYSIS OF AQUEOUS SODIUM OXALATE SOLUTIONS. Juppe, G.; Kolmar, H.; Fantechi, R. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Mar. 1, 1968. 27p. Dep.

The radiolytic decomposition of aqueous 0.1, 0.2, and 0.4$\underline{N}$ sodium oxalate solutions was studied using 2 MeV electrons from a Van de Graaff accelerator. High dose rates (0.2 × 10^6 RAD/sec) were achieved and conversions of the starting material of higher than 99% finally obtained. For the 0.4$\underline{N}$ solution a 0.5 reaction order was established for the oxalate decrease up to 300 × 10^6 RAD total absorption. For the 0.1 and 0.2$\underline{N}$ solutions the same reaction order was observed when irradiating up to 225 × 10^6 RAD absorption. The initial G-values for the oxalate decrease were found to be 0.36, 0.5, and 0.47 for the 0.1, 0.2, and 0.4$\underline{N}$ solutions, respectively. At higher conversions smaller G-values were noted (G oxalate = 0.23 after 75 × 10^6 RAD absorption for the 0.1$\underline{N}$ solution; G oxalate = 0.23 after 200 × 10^6 RAD absorption for the 0.2$\underline{N}$ solution; G oxalate = 0.35 after 300 × 10^6 RAD absorption for the 0.5$\underline{N}$ solution). The kinetics of the oxalate decrease, carbon dioxide formation, and production of neutral functions were studied. (auth)

30587 (EUR-3914(Pt.1)) HIGH DOSE INTEGRATING CHEMICAL DOSIMETERS. THE RADIOLYSIS OF AQUEOUS SODIUM FORMATE SOLUTIONS. Juppe, G.; Kolmar, H.; Fantechi, R. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Mar. 1, 1968. 46p. Dep.

The fast-electron radiolysis of aqueous sodium formate solutions was studied. For a 0.1$\underline{N}$ solution a zero-order kinetics was observed for the decrease in formate up to 83% conversion k = 5×10^{-4} m Eq ml^{-1} sec^{-1}). For the destruction of secondary radiolysis products, oxidizable by permanganate in acid solution, a first-order kinetics was found (k = 6.7×10^{-4} sec^{-1}). The 0.5$\underline{N}$ solution showed linearity between the total dose and reductant formation only up to ~30% conversion of the starting material. The permanganate titration of reductants in acid and alkaline solution and the acid base titration of total and free hydroxide led to the assignment of the following initial G-values for 0.5N solutions:

$G_{\text{permanganate oxidizable compounds in acid solution}} = +3.26$
$G_{\text{permanganate oxidizable compounds in alkaline solution}} = -3.16$
$G_{\text{free hydroxide}} = +0.5$
$G_{\text{total hydroxide}} = +1.2$
$G_{\text{formate}} = -3.3$
$G_{\text{oxalate}} = +2.2$
$G_{\text{carboxyl groups}} = -1.2$
$G_{\text{neutral functions from carboxyl groups}} = +0.8$

(auth)

30588 (HMI-B-66) JAHRESBERICHT 1967. (Annual Report, 1967). (Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany)). May 1968. 185p. (In German). Dep.

Research progress is reported on: range and radiation effects, rare gases in solids, fixation of radioisotopes in solids, preparative radionuclide chemistry, analytical chemistry, age estimation, and transport processes in solutions and biological systems. Radioisotope production, irradiation facilities, and waste processing are also discussed. (M.C.G.)

30589 (NP-17484) HYDRAZINE CATION RADICAL FORMATION IN γ IRRADIATED SINGLE CRYSTALS OF HYDRAZINIUM HYDROGEN OXALATE. Edlund, O.; Lund, A.; Nilsson, A. (Forskningsradens Laboratorium, Studsvik (Sweden)). 1968. 21p. (LF-21). Dep.

Single crystals of hydrazinium hydrogen oxalate, $N_2H_5HC_2O_4$, were irradiated at room temperature in a ^{60}Co gamma source to doses between 3 and 20 MRAD. The ESR spectra of the hydrazine cations formed were recorded with a spectrometer. The complex was found to be planar with the unpaired electron delocalized over the two N nuclei. The radical has a different orientation in the crystal compared with that of the parent ion. (Sweden)

30590 (PRNC-86) HOT-ATOM CHEMISTRY PROGRAM. Progress Summary Report No. 1, July 1964–May 1966. Wheeler, Owen H. (Puerto Rico Nuclear Center, [Mayaguez]). Contract AT(40-1)-1833. 19p. Dep. CFSTI.

Research is reported on hot-atom reactions in organic compounds with multiple covalent bonds between carbon and activated atoms. A detailed study was made of the products formed in thermal-neutron activation of triphenylphosphine, triphenylphosphine oxide, and tetraphenylphosphonium chloride, irradiated in vacuo in the solid state. The ^{35}S products formed in the activation of diphenyl sulfide, sulfoxide, and sulfone were investigated. Neutron activation of diphenylmercury, phenylmercuric chloride, and phenylmercuric acetate was also investigated. (M.C.G.)

30591 (RRL-2310-231) QUARTERLY REPORT [ON RADIATION CHEMISTRY], JANUARY 1, 1968–MARCH 31, 1968. Fundamental Research No. 6041. (Mellon Inst., Pittsburgh, Pa. Radiation Research Labs.). Apr. 10, 1968. Contract AT(30-1)-2310. 15p. Dep. CFSTI.

Developments are reported for studies on: electron decay in pulse-irradiated gases by microwave technique; spectrum and kinetics of hydroxynitromethane anion radical in pulse irradiated alkaline nitromethane solutions; electron scavenging processes in radiolysis of hydrocarbon solutions; oxidation and reduction of nitroalkanes in pulse-irradiated aqueous solutions; transient solvated electron, hydroxyl, and hydroperoxy radicals in pulse-irradiated crystalline ice; formation of phenol and nitrogen by negative ion-molecule chain reaction on irradiation of gaseous benzene–nitrous oxide mixtures; ionic, atomic, and molecular processes in radiation chemistry; repetitive pulse radiolysis; electron scavenging in irradiated cyclohexane solutions; temperature dependence of the positive ion scavenging in cyclopropane–hexane mixtures; positive ion scavenging in c-hexane; radioinduced hydroxylation of fluorobenzene in dilute aqueous solutions; mass spectrometry of discharge flow systems, $N_2 + CH_4$; and electron attachment in pulse-irradiated nitrous oxide. (P.C.H.)

30592 (SRRC-26/68) PRODUCTION OF ^{18}F: SUMMARY. Whitley, J. E. (Scottish Research Reactor Centre, East Kilbride (Scotland)). [1968]. 9p. Dep.

Published methods for the production of ^{18}F are reviewed and an optimum procedure chosen for the conditions pertaining at the Reactor Center. Instructions are given for carrying out this procedure, and modifications suggested for those cases where the end-product is not in a form suitable for projected uses. (auth)

30593 RADIATION CHEMICAL STUDIES WITH PARTICLES OF VERY HIGH LINEAR ENERGY TRANSFER. Burns, W. G.; Marsh, W. R.; Reed, C. R. V. (Atomic Energy Research Establishment, Harwell, Eng.). Nature (London), 218: 867-8(June 1, 1968).

Some experimental work with liquid benzene and liquid cyclohexane at 22 to 25°C using 115-MeV ^{14}N ions and 21-MeV ^{20}Ne ions from the Harwell variable energy cyclotron is reported. The mean LET of the latter particles in these substances is ~125 eV/Å, which is stated to be about four times that of any previously reported radiation chemical study with ion beams. Results are tabulated, and compared with data obtained using electron, proton, deuteron, ^{4}He, ^{60}Co gamma, and fission-fragment beams. The experimental arrangements are briefly described. The $G(H_2)$ value for benzene using ^{20}Ne ions was about 30 times higher than for fast electrons, and the $G(C_2H_2)$ value was the highest recorded. The $G(H_2)$ value from cyclohexane for these ions was intermediate between values for 1.5 MeV ^{4}He ions and for fission fragments; in agreement with the reduction of G(cyclohexene) and G(bicyclohexyl) with increasing LET of the absorbed radiation, these are the lowest values recorded for low dose irradiations of cyclohexane. The G-values for the ^{14}N ions differed very little from those for ~1.0 MeV ^{4}He ions, which have a markedly lower overall LET, a result that can be attributed to the effect of the different secondary electron spectra. The heavier higher energy ion loses a greater fraction of its energy in producing higher energy secondary electrons of low LET. (UK)

30594 ATOMIC RECOIL REACTIONS OF TRITIUM IN BINARY MIXTURES OF BENZENE WITH CYCLOHEXANE IN THE PRESENCE OF DIFFERENT AMOUNTS OF IODINE. Avdonina, E. N.; Minkovskii, E. B. Radiokhimiya, 10: 51-8(1968). (In Russian).

A method for the complete analysis of the products from the atomic recoil reactions of tritium in condensed media was developed. The distribution of the activity between the gaseous, liquid, high-boiling, and polymer products of the atomic recoil reactions of tritium in binary mixtures of cyclohexane with benzene, containing various quantities of iodine, was studied. It was found that in the absence of iodine the benzene yield is a linear function of the mixture concentration. In the case of cyclohexane, deviations from additivity were detected. With increase of the concentration of the iodine, the deviations from additivity for cyclohexane in benzene increases; the quantity of labeled high-boiling products was reduced, and correspondingly the retention in the mother molecule was increased, which agrees with the hypothesis on the "shielding effect" of benzene complexes with iodine. (tr-auth)

30595 ESTABLISHMENT OF ORGANIC BONDS WITH RECOIL ATOMS OF RADIOACTIVE PHOSPHORUS AFTER THE NUCLEAR REACTION ^{35}Cl(n,α)^{32}P IN CHLOROMETHANE. Gabov, N. I.; Korshunov, I. A. Radiokhimiya, 10: 58-63(1968). (In Russian).

The yields of labeled chloromethylphosphinic acid products from the stabilization of radioactive phosphorus in CCl_4, $CHCl_3$, and CH_2Cl_2 were determined by paper chromatography. An inertia effect was detected during the replacement by radiophosphorus atoms of chlorine atoms in the chloromethane molecules. By use of the kinetic theory and investigation of the radioactive recoil atoms in the $CH_2Cl_2-CCl_4$ system, a fluctuation of the mean logarithmic energy loss in collision was detected during formation of the different compounds. This showed that replacement of the chlorine atoms in the chloromethane molecule by radiophosphorus atoms can be explained by elastic interactions, and the replacement of hydrogen atoms obeys the inelastic interaction mechanism. (tr-auth)

30596 FORMATION OF ^{32}P-LABELED ALKYL PHOSPHATES DURING NEUTRON IRRADIATION OF CARBON TETRACHLORIDE WITH ALCOHOL ADMIXTURES. Gabov, N. I.; Korshunov, I. A. Radiokhimiya, 10: 64-70(1968). (In Russian).

The yields of labeled tri- and di-alkyl phosphates, formed during neutron irradiation of carbon tetrachloride with additions of alcohols from methyl to amyl, were determined. It was found that the formation of labeled alkyl phosphates in the targets studied can be explained by a two-stage process. In the first stage, the radiophosphorus recoil atoms interact with chlorine atoms and radicals, produced in the radiolytic decomposition of carbon tetrachloride molecules and form phosphorus chlorides. The effects of the alcohol additions in this stage of the process is insignificant in view of their small concentrations. In the second stage diffusion dissolution of the radical clusters occurs, and labeled phosphorus chlorides are esterified with alcohol molecules to alkyl phosphates. (tr-auth)

30597 THERMAL BEHAVIOUR OF METHANOL SOLUTIONS OF NEUTRON IRRADIATED CHROMIUM(III) ACETYLACETONATE. Gainar, I.; Ponta, A. (Inst. for Atomic Physics, Bucharest). Rev. Roum. Chim., 13: 401-7(Apr. 1968).

The thermal behavior of methanol solutions of the reactor-irradiated chromium(III) acetylacetonate and $^{51}Cr^{3+}$ ions-chromium(III) acetylacetonate isotope exchange was investigated. A transfer of ^{51}Cr-radioactivity to acetylacetonate species was noticed. The transfer isotherms exhibited an initial period of induction followed by a fast transfer stage approaching pseudo-plateaus dependent on temperature. A kinetic analysis of the transfer isotherms was carried out and the transfer activation energy was then calculated. The comparison of the transfer and ^{51}Cr^{3+}-ions-chromium(III) acetylacetonate exchange isotherms revealed some common features suggesting an important contribution of the isotope exchange processes to the transfer of ^{51}Cr-radioactivity to acetylacetonate species. (auth)

30598 INFLUENCE OF FLOW REGIME ON THE PERFORMANCE OF A CONTINUOUS TUBULAR RADIATION CHEMICAL REACTOR. Hill, F. B. (Brookhaven National Lab., Upton, N. Y.); Davis, C. R.; Muller, A. C.; Rothbart, M. A.; Zavadoski, R. W. Trans. Amer. Nucl. Soc., 11: 75-6(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30599 PROCESS RADIATION CHEMISTRY: 1969. Ballantine, D. S. (United States Atomic Energy Commission, Washington, D. C.). Trans. Amer. Nucl. Soc., 11: 84(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30600 GAMMA RADIATION EFFECTS ON SINGLE-CRYSTAL MATERIALS. Van den Bosch, A. (Fysika van de Vaste Stof, Mol, Belgium). Bull. Belg. Phys. Soc., (5), No. 4-5, 263-9 (1967). (In Dutch).

Single crystals of LiF, MgF_2, MgO, Al_2O_3, and SiO_2 were γ irradiated to 6×10^{10} RAD. The choice of material is based on the valence of the ions. On these samples optical absorption and magnetic susceptibility measurements were carried out. The data gathered on the fluorides contain indications for displacements, those on the oxides do not. In the halides the mean energy spent for causing primary defects is smaller in LiF than in MgF_2. The behavior of the γ-irradiated LiF single crystals is compared to that of neutron-irradiated samples. (auth)

30601 CHEMICAL ENRICHMENT OF RADIONUCLIDES FROM SOLUTIONS. Collins, Kenneth E. (State Univ. of New York, Buffalo); Collins, Carol H. Trans. Amer. Nucl. Soc., 11: 77(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30602 RADIATION STABILITY OF EPOXY RESINS. PART I. EFFECT OF THE TYPE OF CURING AGENT ON THE RADIATION STABILITY OF CURED EPOXY RESINS. Birkin, N. A.; Neverov, A. N.; Bocharnikov, V. K. Mekh. Polim., No. 3, 476-82(1967). (In Russian).

The effect of ^{60}Co γ radiation on ED-6 epoxy resin cured with various agents (phthalic and maleic anhydrides, m-phenylenediamine, hexamethylenediamine, triethanolamine titanate) was studied to determine the nature of the radiochemical processes occurring in the cured resin during irradiation. The physicomechanical properties of the compositions studied were measured, the degree of variation of the gel fraction was determined, thermomechanical curves were plotted, and IR absorption spectra were recorded. The type of curing agent was found to have a decisive effect on the radiation stability of the epoxy compositions. Use of phthalic anhydride considerably increases this stability, the predominant process involved being radiation crosslinking. Degradation processes due to the rupture of bridge links of the curing agent in the system are very insignificant thanks to the chemical shielding provided by the benzene rings in the molecule of the curing agent. When aliphatic anhydrides such as maleic anhydride are used as curing agents, the crosslinking and degradation processes occur at approximately equal rates, crosslinking being slightly predominant; the associated structural changes are due to the rupture of double bonds in the bridge of the curing agent. In the composition cured with hexamethylenediamine, the chief processes during irradiation are those of degradation, mainly involving rupture of the chain formed by six methylene groups in the chain of the curing agent. The diverse nature of the radiochemical processes taking place during irradiation of the compositions is reflected in the difference in the nature and degree of change of the physicochemical properties resulting from the irradiation. (ATD)

30603 RADIATION-INDUCED PRODUCTION OF DIBUTYLTIN DIBROMIDE AT HIGH TEMPERATURES. Hallman, D. F.; Welt, M. A. (North Carolina State Coll., Raleigh). Trans. Amer. Nucl. Soc., 11: 85(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30604 PREPARATION OF SYNTHETIC LATEX USING ^{60}Co RADIATION. Stannett, V. (North Carolina State Coll., Raleigh); Gervasi, J. A.; Kearney, J. J.; Araki, K. Trans. Amer. Nucl. Soc., 11: 84-5(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30605 RADIATION-INDUCED DECOMPOSITION OF METHYL IODIDE IN AIR. Tang, I. N.; Castleman, A. W. Jr. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc., 11: 76-7(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30606 TRAPPED RADICALS IN INORGANIC GLASSES. Treinin, A. (Hebrew Univ., Jerusalem). pp 525-78 of Radical Ions. Kaiser, E. T.; Kevan, L. (eds.). New York, John Wiley and Sons, Inc., 1968.

A review is presented on radicals trapped in inorganic glasses. Low- and room-temperature glasses are described since many radicals have been investigated in both kinds of media. The discussion of frozen aqueous solutions also includes polycrystalline samples, because in many cases the ESR spectra of the radicals were measured in polycrystalline ice whereas the corresponding mineral acid glasses were used for recording the optical spectra. The term radical is used to encompass transition group ions that are not stable in aqueous solution. The vitreous state and the production of trapped radicals and their detection are also reviewed, along with radioinduced color centers in pure glasses. Results on inorganic radicals show that the radioinduced impurity centers are very often definite chemical species, produced by reduction or oxidation processes. The review of organic radicals in inorganic glasses is included to emphasize the role of the matrix in photoionization processes. (148 references). (P.C.H.)

30607 FRAGMENTS IN IRRADIATED IONIC SOLIDS. Cunningham, Joseph (University Coll., Dublin). pp 475-523 of Radical Ions. Kaiser, E. T.; Kevan, L. (eds.). New York, John Wiley and Sons, Inc., 1968.

The need to distinguish clearly between primary and secondary species formed by radiation is illustrated by data on reduction effects in crystalline nitrates. In studying the nature and mechanism of formation of primary radical species, it is necessary to distinguish carefully between energy localization at trapping sites existing prior to irradiation and energy localization at trapping sites generated by irradiation. Trapping at radiation-produced fragments accounts for a large proportion of the reported radiation damage in inorganic crystals. ESR signals which have been widely assigned to NO_3^{2-} radicals upon normal lattice sites pose the problem of identifying a mechanism for localizing the extra electron upon one of an array of identical nitrate ions. A mechanism based on trapping at nitrate ions temporarily distorted by radiation-induced intramolecular configuration change is discussed. It appears to be consistent with reported results for the stability of NO_3^{2-}, NO_3, CO_3^{2-}, and CO_3^{-} radicals. The mechanism must remain tentative until uncertainties in the assignments of ESR data to these radicals are finally resolved and trapping sites are unambiguously identified. Studies of the spatial distribution of primary radicals, such as CO_3^{2-} in calcite, have failed to provide conclusive evidence that they are located according to the predictions of energy-loss models. Evidence for rapid transport of electronic energy away from the site of energy deposition in solids possessing long-range order is discussed. Rapid transport of electronic energy away from the site of energy deposition reduces the probable importance of thermal spikes in the formation of products at high LET. Diffusion models based on second-order interactions between excited ions at high LET are affected to lesser extent by long-range order. The chemical consequences of the displacement spike model are difficult to observe but this model provides the most probable mechanisms for track imaging even with low LET radiation. (112 references). (auth)

30608 IONIC PROCESSES IN γ-IRRADIATED ORGANIC SOLIDS AT $-196°$. Hamill, William H. (Univ. of Notre Dame, Ind.). pp. 321-416 of Radical Ions. Kaiser, E. T.; Kevan, L. (eds.). New York, John Wiley and Sons, Inc., 1968. (COO-38-481).

The following topics are discussed: experimental procedures; electrons and anions; positive holes and cations; electrons in 3-methylpentane; trapped electron in methyltetrahydrofuran; electron attachment by biphenyl; dissociative electron attachment; positive hole trapping in 3-methylpentane systems; cations in polycrystalline CCl_4; cations in glassy butyl chloride; and chemical effects. (P.C.H.)

30609 MIN-MAX METHOD OF ISOTOPE PRODUCTION. Eckhoff, N. D.; Fan, L. T.; Kimel, W. R. (Kansas State Univ., Manhattan). Trans. Amer. Nucl. Soc., 11: 96-7(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30610 CHARACTERISTICS OF STEPWISE RECOMBINATION OF RADICALS IN IRRADIATED POLYDIMETHYLSILOXANE. Fedoseeva, T. S.; Kuz'minskii, A. S. (Scientific Research Inst. of the Rubber Industry, Moscow). Khim. Vys. Energ., 1: 248-52(1967). (In Russian).

The ESR method was used to study the recombination of free radicals in polydimethylsiloxane irradiated with ^{60}Co γ rays in a vacuum at −196°C. In the temperature range below the glass-transition temperature, practically no recombination takes place; in the vitrification range and above, the kinetics of disappearance of radicals have a stepwise character, the interval between the steps being dependent on the temperature and density of the three-dimensional network in the sample. On the basis of experimental data a qualitative picture of the distribution of radicals over the recombination temperatures as a function of the quantity of cross-linkages was obtained. It is postulated that such a distribution is determined not only by the distance between the radicals, but also by the position of the radical relative to the crosslinkage. (ATD)

30611 CHEMICAL PRODUCTS OF NUCLEAR REACTION ^{37}Cl(n,γ)^{38}Cl IN ORGANIC COMPOUNDS. I. CHEMICAL REACTIONS OF ^{38}Cl RECOIL ATOMS IN LIQUID MIXTURES OF CARBON TETRACHLORIDE WITH METHYL, N-PROPYL AND ISOPROPYL ALCOHOLS. Vasaros, Laszlo; Berei, Klara; Kiss, Istvan (Inst. for Research in Physics, Budapest). Magy. Kem. Foly., 74: 106-12(Mar. 1968). (In Hungarian).

Chemical reactions of ^{38}Cl atoms formed during irradiation of liquid binary CCl_4 mixtures with methyl, propyl, and isopropyl alcohols in a nuclear reactor were investigated. Yields of separate radioactive products were determined as a function of the concentration of alcohols. Experimental data were obtained on the stabilization of chlorine recoil atoms forming labeled products. High-energy and thermal processes in ^{38}Cl secondary reactions are discussed. (R.V.J.)

30612 COVERING OF RADIOACTIVE AND IRRADIATED POTASSIUM SULFATE CRYSTALS BY METAL SOLS. Gromov, V. V.; Trofimov, V. I.; Luk'yanovich, V. M.; Spitsyn, Vikt. I. (Inst. of Physical Chemistry, Moscow). Dokl. Akad. Nauk SSSR, 178: 1307-8(Feb. 21, 1968). (In Russian).

Particles of a charged sol are absorbed primarily on charged portions of a surface. In dielectrics the surface charge can be retained for a considerable time. Silver in acetone where the sol particles are negative, and nickel in methyl alcohol where the sol particles are positively charged were used to investigate the surface charge on radioactive K_2SO_4 (tagged with ^{35}S), and on beta and gamma irradiated K_2SO_4 crystals. After treatment with the sol solution, the K_2SO_4 crystals were dried in air, and a carbon film 100 to 200 Å thick was evaporated onto the crystals. The carbon film with adherent sol particles was floated off by dissolving the crystals in water. An electron microscopic study of the replicas showed that the radioactive K_2SO_4 crystals were covered with a dense layer of colloid silver particles which were absorbed on irregular points of the surface relief. Irradiation with ^{60}Co gamma rays gave a negatively charged surface which was readily covered by the positively charged particles of the nickel sol. Thus, it was possible to determine the sign and amount of surface charge by treatment with a metal sol and subsequent examination of the surface replica on an electron microscope. (TTT)

30613 ELECTRON SPIN RESONANCE STUDIES OF FREE RADICALS IN γ-IRRADIATED AMINO ACID CRYSTALS: α-AMINO ISOBUTYRIC ACID AND L-LYSINE · HCl · $2H_2O$. Fujimoto, M.; Seddon, W. A.; Smith, D. R. (Atomic Energy of Canada Ltd., Chalk River, Ont.). J. Chem. Phys., 48: 3345-50(Apr. 15, 1968).

Single crystals of α-amino isobutyric acid and L-lysine monohydrochloride dihydrate were γ irradiated at 77°K and electron spin resonance spectra were observed in the temperature range between 77 and 298°K. It was confirmed that the stable radicals, $(CH_3)_2\dot{C}COOH$ and $H_2N(CH_2)_3CH_2\dot{C}HCOOH$, formed from these two amine acids, respectively, are not direct products of irradiation but are formed thermally by an inter- (or intra-) molecular reaction involving intermediate radicals in the crystals. The intermediate radicals formed at 77°K are similar in these materials and are believed to be involved in the mechanism of amino-group abstraction. The radical $H_2N(CH_2)_3CH_2\dot{C}HCOOH$ in L-lysine · HCl · $2H_2O$ exhibits different ESR spectra at different temperatures corresponding to different conformations in the crystal lattice. (auth)

30614 ELIGIBLE KINSFOLK OF URANIUM. Seaborg, Glenn T. (Atomic Energy Commission, Washington, D. C.). New Sci., 38: 410-13(May 1968).

Some of the intriguing possibilities for the production of numerous isotopes of the synthetic elements heavier than U are discussed, and some applications are mentioned. (P.C.H.)

30615 ISOTOPIC LABELLING STUDIES IN IRRADIATED ORGANIC SOLUTIONS. Burr, J. G.; Cher, M.; Yang, J. Y. (North American Aviation Science Center, Thousand Oaks, Calif.). J. Label. Compounds, 4: 67-71(Jan.-Mar. 1968).

Non-linear interactions between solvent and solute were observed in the radiolysis of binary organic mixtures. The use of labeled molecules to diagnose both the nature of the excited solvent species and also the nature of the interaction between these excited species and the solute molecules are described. The particular systems discussed in detail are: cyclohexane + ^{14}C-benzene; tritiated cyclohexane + ^{14}C-benzene; tritiated cyclohexane + benzoquinone; tritiated cyclohexane + cyclopentene; cyclohexane + ^{14}C-cyclohexene; cyclohexane or cyclohexane d_{12} + benzene or benzene-d_6; cyclohexane-d_{12} + cyclopentane; various mixtures of cyclohexane, cyclopentane, and deuterated analogs with corresponding olefins and the deuterated olefins; mixtures of light and heavy water vapor with cyclopentane, methane, cyclohexane and other hydrocarbons. Analysis of the products obtained in the irradiation of these systems has been informative about the nature of the quenching and scavenging processes that take place and also about the nature of the reactive species involved. (auth)

30616 INFLUENCE OF CRYSTAL DEFECTS ON PHOTO-ANNEALING OF CHEMICAL RADIATION DAMAGE. Mohanty, S. R.; Nair, S. M. K. (Utkal Univ., Bhubaneswar, India). Curr. Sci. (India), 37: 283-4(May 20, 1968).

Two samples of 85- to 100-mesh size lead nitrate crystals were irradiated either with ^{60}Co γ rays or with γ rays plus neutrons. The results showed that the material irradiated with γ rays plus neutrons underwent photoannealing at a greater rate than that irradiated with γ rays alone; the velocity constants were 0.000432 and 0.000173 hr^{-1}, respectively. For a given light frequency the recovery was also greater for reactor irradiation than for pure γ rays. The recovery in both cases was linearly related to the light frequency. However, the threshold frequency for annealing, 42×10^{13} sec^{-1} corresponding to 1.74 eV and 40.1 kcal $mole^{-1}$, was independent of the defect concentration. (P.C.H.)

30617 INFLUENCE OF RADIOACTIVE IRRADIATION ON THE PROPERTIES OF POLYAMIDE AND POLYESTER FIBERS. Velitsin, M. N. Tekst. Prom., No. 4, 68-71(1967). (In Russian).

The effect of ^{60}Co γ irradiation on the tensile strength of capron, anide, and lavsan fibers was determined. All fibers were of 29 tex × 80 (No. 34.5/80). The fibers were irradiated in air at 20°C with the integral radiation dosages of 5, 10, 16, 20, 30, 40, 50, 60, 70, 80, 90, 100, 140, and 250 m RAD. Experimental results are shown graphically. The dependence of the coefficient of tensile strength of capron and anide fibers on the radiation dosage (γ) is given by the relationship:

$$K_p = \frac{1}{e^{\frac{\gamma}{34}}}$$

and the coefficient of tensile elongation, by the relationship

$$K_\epsilon = \frac{1}{e^{\frac{\gamma}{40}}}$$

The corresponding relationships for lavsan fibers are given by the following equations (depending on the magnitude of the radiation dosage): $K_p = -0.00009\gamma^2 + 0.0018\gamma + 1$, $\gamma = 0 + 30$, $K_p = -0.0036\gamma + 1.081$, $\gamma = 30 + 250$, $K_\epsilon = -0.0002\gamma^2 + 0.0094\gamma + 1$, $\gamma = 0 + 30$, $K_\epsilon = -0.0041\gamma + 1.225$, and $\gamma = 30 + 250$, respectively. It was concluded that the maxima observed in the curves of the tensile strength and tensile elongation of polyester fibers, i.e., lavsan, are due to partial crystallization and/or cross-linkage of the polyester molecules in the fibers. (ATD)

30618 ION FORMATION IN DITHIODIGLYCOLIC ACID IRRADIATED AT 4.2°K. Box, Harold C.; Freund, Harold G.; Frank, Gerard W. (Roswell Park Memorial Inst., Buffalo). J. Chem. Phys., 48: 3825-6(Apr. 15, 1968). (NYO-3558-13).

Single crystals of dithiodiglycolic acid were subjected to ionizing radiation while maintained at a temperature of 4.2°K. Electron spin resonance (ESR) spectroscopy showed that electron vacancies in ionized molecules, created initially in a random fashion, were transferred to the disulfide group. The electron produced by the ionization process became trapped on the disulfide group of a neighboring dithiodiglycolic acid molecule. Thus anions and cations were formed, both of which have the unpaired electron localized on the disulfide group. (auth)

30619 FREQUENCY-SWEPT ELECTRON–ELECTRON DOUBLE RESONANCE: SEPARATION OF OVERLAPPING SPECTRA IN IRRADIATED MALONIC ACID. **Hyde, James S.** (Varian Associates, Palo Alto, Calif.); Kispert, Lowell D.; Sneed, Robert C.; Chien, James C. W. J. Chem. Phys., 48: 3824-25(Apr. 15, 1968).

Intramolecular relaxation processes in single crystals of γ-irradiated malonic acid were found to exist near room temperature for the two radicals analyzed by Horsfield et al., $\dot{C}H_2(CO_2H)$ and the spectroscopically inequivalent $\dot{C}H_2(CO_2H)$. The spectra were separated using electron–electron double resonance. The radical, $\dot{C}H(CO_2H)_2$, studied previously by McConnel et al., gave essentially no double resonance signals. All signals decreased in intensity when the temperature was lowered below 0°C. (D.H.M.)

30620 KINETICS OF RADIATION POLYMERIZATION IN CHANNEL COMPLEXES. I. ACRYLONITRILE POLYMERIZATION IN UREA CHANNEL COMPLEX. Kiss, Laszlo. Magy. Kem. Foly., 74: 125-8(Mar. 1968). (In Hungarian).

The kinetics of radiopolymerization of acrylonitrile in urea channel complexes were studied. From experimental data obtained the ratio between monomer components was determined: urea 1 mole : 1 mole complex formed during 48 hr. Oxygen did not influence the rate of polymerization. In the channel the rate of polymerization was several orders higher than in acrylonitrile polymerization in the block. Polymerization kinetics in the complex was of self-accelerating character. At comparatively high-energy doses the polymerization rate was in direct proportion to the zero energy dose and at low energies it was in the first power. (R.V.J.)

30621 KINETICS OF RADIATION POLYMERIZATION IN CHANNEL COMPLEXES. II. ACRYLONITRILE POLYMERIZATION IN THE UREA CHANNEL COMPLEX. Kiss, Laszlo; Balint, Szabolcs (Muanyagipari Kutato Intezet, Budapest). Magy. Kem. Foly., 74: 128-31(Mar. 1968). (In Hungarian).

The kinetics of acrylonitrile post polymerization in urea channel complex polymerization at −35 to −78°C temperatures was investigated. Data obtained showed that at the beginning polymerization kept growing to a certain point after which it began to reduce to zero. The higher temperature inhibited the polymerization. At the dose studied, the amount of polymer, obtained from the post-polymerization, varied as a function of the dose along the curve with the maximum. However, the amount of a polymer produced by direct polymerization and by post-polymerization steadily increased depending on the dose. The general energy of the activation process in the temperature range from −35 to −54°C was negative and at lower temperatures it was positive. In the dose range studied, the rate of polymerization varied linearily with the dose. (tr-auth)

30622 PREPARATION AND IDENTIFICATION OF DIVALENT LANTHANIDE IONS AS DILUTE SOLUTES IN ALKALINE EARTH HALIDE SOLID SOLUTIONS. Yocom, P. N. (Radio Corp. of America, Princeton, N. J.). Contracts AF33(657)-11221; AF33-(616)-8199; AF33(615)-1096. Advan. Chem. Ser., 71: 51-5(1967).

From Symposium on Lanthanide/Actinide Chemistry, New York. See CONF-660962.

Each of the lanthanide elements can be obtained as a divalent ion in dilute solution with alkaline earth halides as the solvent in either the fused state (by metallic reduction with either lanthanide or alkaline earth metal, or photoreduction with ultraviolet or gamma radiation) or solid state either by gamma irradiation, metallic reduction with alkaline earth metal, or electrolysis. The divalent species was identified by absorption and emission spectroscopy and/or electron paramagnetic resonance. Those divalent ions showing definite 4f configuration in their ground states are Pr, Dy, Ho, Er, Tm, Sm, Eu, and Yb. The remaining ions, La, Ce, Nd, Gd, and Tb have 5d ground states or a low lying 4f to 5d transition, as is probably the case with Nd. (auth)

30623 PULSE RADIOLYSIS OF CARBON MONOXIDE. Willis, C. (Chalk River Nuclear Labs., Ont.); Devillers, C. Chem. Phys. Lett., 2: 51-3(May 1968).

Carbon monoxide has been irradiated with intense pulses of 1-MeV electrons and two transient absorption spectra have been observed. One of these consisted of a series of bands extending from 5000 to 8600 Å and the second a single line at 2479 Å. The species giving rise to the band system is probably $C_2O(^3\Sigma)$ and that to the single line $C(^1S)$. It is proposed that carbon atoms are not the exclusive precursors of $C_2O(^3\Sigma)$ in the system and a reaction, such as $CO^* + CO \rightarrow C_2O(^3\Sigma) + O$, involving electronically excited carbon monoxide is occurring. (auth)

30624 RADIOLYSIS OF BINARY MIXTURES. PART VIII. TRITIUM LABELLING BY DIRECT RADIATION SYNTHESIS. THE METHANOL–BENZENE SYSTEM. Ekstrom, A.; Garnett, J. L. (Univ. of New South Wales, Kensington, Australia). J. Label. Compounds, 4: 43-53(Jan.-Mar. 1968).

A novel synthesis of tritiated compounds is reported using the direct irradiation of an aromatic-aliphatic mixture, one of the components of which is labeled with tritium. The irradiation of the methanol-tritiated benzene system has been used to illustrate the principle of the technique. The gamma irradiation of methanolic solutions of tritiated benzene yields the following tritiated scavenging products, some of which are specifically labeled under certain conditions: anisole; 1,3- and 1,4-cyclohexadienes; 2,5-phenylcyclohexadiene; 1,3- and 1,4-cyclohexadiene-methanols. The potential of the method as a general tritium labeling tool is discussed and compared with conventional procedures. Although the absolute yields of the labeled products from direct irradiation are small for relatively large total radiation doses (Mrads), scavenging by non-labeled parent material can be used to give large chemical yields if required. The predominant advantage of the present method is that compounds labeled in specific positions with tritium can be obtained in a one-step chemical process whereas this synthesis may be difficult by other conventional labeling methods. (auth)

30625 RACEMIZATION OF ISOTACTIC POLYMETHYLMETHACRYLATE BY ULTRA-VIOLET AND GAMMA IRRADIATIONS. David, C.; Verhasselt, A.; Geuskens, G. (Univ. of Brussels). Polymer, 9: 287-8(May 1968).

A comparison was made on the efficiency of uv and γ irradiations for the racemization of isotactic poly(methyl methacrylate). The tacticity of the samples before and after irradiation was determined from the NMR spectra recorded on a Varian A-60 spectrometer in deuterated chloroform at room temperature. The racemization yields were calculated from the decrease of the number of meso pairs (dd or ll). It was found that the same amount of racemization requires the dissipation of less energy by γ than by uv irradiation. (P.C.H.)

30626 RADIATION CHEMISTRY OF CONVERSION IN NITROSYL PERCHLORATE. Belevskii, V. N.; Rumyantsev, E. S.; Rosolovskii, V. Ya. Zh. Neorg. Khim., 13: 897-9(Mar. 1968). (In Russian).

Gamma irradiation of $NOClO_4$ crystals at −196°C led to the formation of the radicals NO_2, ClO_3, and ClO_2. At increase of the temperature to −50°C the concentrations of NO_2 and ClO_2 were practically unchanged, but the concentration of ClO_3 increased somewhat. Above −50°C a rapid destruction of the radicals NO_2 and ClO_3 and an increase of the yield of ClO_2 occurred. At room temperature only the radical ClO_2 was observed in the irradiated $NOClO_4$. A possible mechanism for the formation and destruction of the radicals in the irradiated nitrosyl perchlorate is given. (tr-auth)

30627 RADIATION-INDUCED TRAPPED ELECTRONS IN SATURATED HYDROCARBONS STUDIED BY OPTICAL AND ELECTRON SPIN RESONANCE SPECTROSCOPY. Lin, Jacob; Tsuji, Kozo; Williams, Ffrancon (Univ. of Notre Dame, Ind. Univ. of Tennessee, Knoxville). Contract AT-(40-1)-2968. J. Amer. Chem. Soc., 90: 2766-74(May 22, 1968). (ORO-2968–29).

A comprehensive study is reported on the production of trapped electrons in several saturated hydrocarbon glasses by γ irradiation and photoionization. Optical and ESR detection methods have been used to determine radiation-chemical yields and to follow thermal decay. For glasses of high viscosity, the trapped electron is thermally stable at 77°K. $G(e^-)$ for 3-methylhexane was found to be 0.89 by optical and 0.87 by ESR determinations. A satisfactory correlation was also obtained for the corresponding yields in other hydrocarbon glasses, but the absolute values were lower. The magnitude of the yield appeared to be influenced by the constitution of the glassy state, and semicrystalline hydrocarbons gave the lowest G-values. Thermal decay of the trapped electron in 3-methylpentane and in 3-methylpentane–isopentane mixtures at 77°K has been examined in considerable detail. Under conventional experimental conditions, a faster decay was observed by ESR compared to the results obtained by optical study on the same material. The possibility is raised that this apparent difference may be due to sample size. Although the absolute values for the half-decay times $t_{1/2}$ as determined by optical and ESR methods do not agree, each set of experimental results shows that $t_{1/2}$ depends on the half-power of viscosity. (auth)

30628 RADICAL AND MOLECULAR YIELDS IN THE γ-RADIOLYSIS OF WATER. V. THE SODIUM HYPOBROMITE SYSTEM. Buxton, G. V.; Dainton, F. S. (Leeds Univ., Eng.). Proc. Roy. Soc. (London), Ser. A, 304: 441-7(May 7, 1968).

The radiolysis of alkaline aqueous solutions of sodium hypobromite was investigated to determine the effects of high pH on the primary radical yields. The reaction mechanism was fully established only when sodium bromite was present to capture BrO radicals, and the results showed $G_{e_{aq}^-} + G_H = 2.9$, $G_{OH} = 2.3$, $G_{H_2O_2} = 0.7$ and $G_{H_2} = 0.4$ up to pH 13. In the presence of N_2O $G(N_2)$ increased by 0.3 between pH 12 and 14, which is thought to be due to some process other than the conversion of H to e_{aq}^-. (auth) (UK)

30629 RADIOLYSIS OF AQUEOUS SOLUTIONS OF OXYBROMINE COMPOUNDS: THE SPECTRA AND REACTIONS OF BrO AND BrO_2. **Buxton, G. V.; Dainton, F. S.** (Leeds Univ., Eng.). Proc. Roy. Soc. (London), Ser. A, 304: 427-39(May 7, 1968).

Pulse radiolysis supplemented by steady state radiolysis of aqueous solutions containing some of the solutes N_2O, Br^-, BrO^-, BrO_2^-, BrO_3^-, CO_3^{2-}, and OH^- was used to identify the absorption spectra of BrO ($\lambda_{max.} = 350$ nm) and BrO_2 ($\lambda_{max.} = 475$ nm) and to evaluate the following rate constants (units, M^{-1} S^{-1}): $e_{aq}^- + BrO^- \rightarrow Br^- + O^-$ ($2.3 \pm 0.5 \times 10^{10}$); $e_{aq}^- + BrO_2^- \rightarrow BrO + O^{2-}$ ($1.8 \pm 0.2 \times 10^{10}$); $e_{aq}^- + BrO_3^- \rightarrow BrO_2 + O^{2-}$ ($4.1 \pm 0.2 \times 10^9$); $OH + BrO^- \rightarrow OH^- + BrO$ (4.5×10^9); $O^- + BrO^- \rightarrow BrO + O^{2-}$ (4.6×10^8); $OH + BrO_2^- \rightarrow OH^- + BrO_2$ (1.9×10^9); $Br_2^- + BrO^- \rightarrow BrO + 2Br^-$ ($8.0 \pm 0.7 \times 10^7$); $Br_2^- + BrO_2^- \rightarrow BrO + Br^- + BrO^-$ ($8.0 \pm 0.8 \times 10^7$); $BrO + BrO_2^- \rightarrow BrO + BrO_2$ ($3.4 \pm 0.7 \times 10^8$); $2BrO_2 \rightleftharpoons Br_2O_4$ ($k = 1.4 \times 10^9$ and $K = 10M^{-1}$); $Br_2O_4 + OH^- \rightarrow H^+ + BrO_2^- + BrO_3^-$ (7×10^8); $2BrO + H_2O \rightarrow BrO^- + BrO_2^- + 2H^+$ ($4.9 \pm 1.0 \times 10^9$); $CO_3^- + BrO^- \rightarrow CO_3^{2-} + BrO$ ($4.3 \pm 0.4 \times 10^7$); and $CO_3^- + BrO_2^- \rightarrow CO_3^{2-} + BrO_2$ ($1.1 \pm 0.1 \times 10^8$). (auth) (UK)

30630 RADIATION-CHEMICAL FIXATION OF MOLECULAR NITROGEN BY ORGANIC COMPOUNDS. **Podkhalyuzin, A. T.; Vereshchinskii, I. V.** Dokl. Akad. Nauk SSSR, 178: 1123-5 (1968). (In Russian).

Diphenylmethane was chosen as the organic compound to fix nitrogen. The G yield of H_2 was 0.06, and the G yield of the dimer (tetraphenylethane) was 0.27 on irradiating diphenylmethane (DPM) in argon with 300 keV electrons at 40°C. In a DPM-nitrogen system containing p-benzoquinone, the G yield of dimer did not change but it decreased to 0.13 on adding iodine to the system (0.5×10^{-2} mole per mole diphenylmethane). The G yield of H_2 remained unchanged in the presence of iodine. The decrease in dimer yield was apparently due to the reaction of the diphenylmethyl radical with iodine. The concentration of bound nitrogen, however, did not change in the presence of the acceptor. The fixation yield for nitrogen $G(-N_2)$ was 0.08. Electrolysis experiments showed that ions took part in the fixation of molecular nitrogen. (TTT)

30631 RADIOLYSIS OF METHANE ADSORBED ON γ ALUMINA AT 77°K. **Swan, T.** (Central Electricity Generating Board, Berkeley, Eng.). Nature (London), 218: 868-9(June 1, 1968).

Studies were made using a dose rate to alumina of 3.14×10^{19} eV/g/h from a ^{60}Co gamma source. The methane was adsorbed to a coverage of 0.28% of the BET area. The average G-values up to a dose of 1.41×10^{21} eV/g for the principal products (H_2, C_2H_6, C_2H_4, C_3H_8, C_3H_6) are tabulated. The results suggest that some, but not all, of the energy absorbed by the solid was transferred to the methane. Whereas all the methane from an unirradiated sample was desorbed below 24°C, only a fraction of the gases from an irradiated sample was desorbed at that temperature. The temperature of an irradiated sample had to be raised to 100°C before any further gas was evolved, and to 400°C for removal of all the gas. The percentage of total recovered chemisorbed methane was plotted against dose. The G-value of 1,680 for methane chemisorption suggests that this process involved energy deposited in the solid. $G(-CH_4)$ increased initially with dose until a steady value was reached, and this was maintained for a small dose increment, after which it decreased to approximately its initial value. Post-irradiation chemisorption was observed at 77°K. A mechanism is suggested to explain the results. Physisorbed products may arise either from the decomposition of physisorbed methane, or from reactions of chemisorbed intermediates leading to the destruction of chemisorption bonds, but the former seems more likely. (UK)

30632 SEMICONDUCTOR CATALYSIS OF SOLID INORGANIC COMPOUND RADIOLYSIS. **Zakharov, Yu. A.; Nevostruev, V. A.** (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol., 11: 153-7(1968). (In Russian).

The influence of mechanical semiconductor impurities (ZnO, NiO, CoO, ThO_2, ZnO(Al), and ZnO(Li)) on the radiolysis of potassium, sodium, and ammonium nitrates was investigated. Comparisons were made of the influence of impurities on the rate of processes in thermolysis, photolysis, and radiolysis. (R.V.J.)

30633 STUDY BY ELECTRON PARAMAGNETIC RESONANCE OF THE FREE RADICALS PRODUCED BY γ-IRRADIATION AT 77°K OF GLOBULAR DERIVATIVES OF METHANE AND SILANE. **Roncin, Jacques** (Faculte des Sciences, Orsay, France). Mol. Cryst., 3: 117-44(1967). (In French).

A comparative study was made of the radiolysis of methylchloromethanes and methylchlorosilanes, as examined by EPR of radicals formed by γ irradiation of the solid phase. In compounds of general formula $(CH_3)_nCCl_{4-n}$, γ irradiation at 77°K created free radicals by C−Cl bond rupture, but for $(CH_3)_nSiCl_{4-n}$ compounds both C−H, Si−C, and Si−Cl breakages occurred. A study of the ESR spectra of $\dot{C}(CH_3)_3$ in $(CH_3)_3CCl$, $(CH_3)_2\dot{C}Cl$ in $(CH_3)_2CCl_2$ and $\dot{C}H_2(CH_3)_2SiCl$ in $(CH_3)_3SiCl$ showed the influence of the matrix on the structure of the trapped free radical. The hyperfine coupling constant found for the ^{29}Si interaction ($\underline{a}$ $^{29}Si = 416$ G) in the $^{29}\dot{S}iCl_3$ free radical showing that $\dot{S}iCl_3$ is not a π-planar radical, and that the percentage of $\underline{s}$ character of the orbital occupied by the solitary electron is ~34.5. As was found for all members of the series studied, the radicals in CH_3SiCl_3 disappeared only near the melting point (198°K). (BBB)

30634 THE EFFECTS OF GAMMA RADIATION ON HALOTHANE. **Pennington, Sam N.** (Univ. of Texas Medical Branch, Galveston). **Anesthesiology, 29**: 153-4(Jan.-Feb. 1968).

Studies of the effects of γ radiolysis on anesthetic agents were carried out to determine the usefulness of these stored materials following nuclear attack. Among the compounds studied, 1,1,1-trifluoro-2-chloro-2-bromoethane (Halothane) was of particular interest. Samples of Halothane irradiated with doses of 0.93 to 7.85×10^{22} eV were examined by gas chromatography. A comparison of an irradiated sample with a control sample showed that the irradiated sample had undergone a significant change. Chromatographic peaks 2 and 3 were identified as dichlorohexafluorobutene by comparison with chromatograms of known samples. The dependence of the presence of this compound on radiolysis was evident. A linear relation existed between the amount of dichlorohexafluorobutene present and the radiation dose. The presence of dichlorohexafluorobutene in the irradiated samples casts serious doubt on the use of Halothane following its exposure to ionizing radiation, especially in view of the report on the toxicity of this compound. (BBB)

30635 THERMOLUMINESCENCE OF SOME PHOSPHORUS-BASED COMPOUNDS. **Bettinali, Carlo; Ferraresso, Gastone; Granati, Paolo** (CNEN, Rome. Univ., Rome). Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur., 42: 814-23(June 1967).

Experiments were conducted on the following x-irradiated compounds: crystalline phosphates of the type MeH_2PO_4, where Me is Na, K, Rb, Cs, and NH_4; sodium phosphates with varying Na/O ratios; and, compounds in which the phosphorus is bound not only to oxygen but also to different atoms such as in $POCl_3$ and PCN. The data seem to indicate that no relation exists between the point of transformation and thermoluminescent peaks. Apparently metastable levels responsible for thermoluminescence are only slightly influenced by the type of cation and not at all influenced by phase transition. (J.G.B.)

30636 ELECTRON-SPIN-RESONANCE STUDIES OF RADIATION-INDUCED PARAMAGNETIC DEFECTS IN SEVERAL GLASS SYSTEMS. **Kim, Yong Moo.** Providence, Brown Univ., 1967. 145p.

Thesis.

ESR studies of γ-irradiated glasses from three oxide systems; alkali oxide−titanium oxide; niobium pentoxide−sodium oxide−silicon dioxide; lead oxide−boron oxide, are reported. All the glasses received a γ dose of 2×10^7 R, and were investigated at liquid nitrogen temperature. In alkali titanate glasses, the radioinduced spectrum can be separated into two distinct resonance lines: one line is located at a g-value higher than that of the free electron, g_e, while the other is lower. The latter spectrum consists of two different resonance lines: the so-called broad and sharp spectra. They are identified as arising from two different Ti^{3+} centers. In the $Nb_2O_5-Na_2O-SiO_2$ glasses, radioinduced paramagnetic center gives rise to the so-called broad spectrum, which is characterized by an axially symmetric g-factor and hyperfine interaction with the $Nb(I = 9/2)$ nucleus. By comparing ESR parameters for the broad spectrum with those reported for Nb^{4+} complexes in solutions and different alcoholic glasses, this center is identified as a Nb^{4+} complex. A separate, narrow spectrum was obtained in approximately the center of the broad spectrum. The narrow spectrum results from the combined effects of three different ESR centers. One center appears to be that identified by Yudin as the characteristic spectrum of Na_2O-SiO_2 glass. Thermal treatments of the glass also revealed an asymmetric, structureless line on the high-field side. In addition to these two centers, a nearly isotropic spectrum having ten hyperfine lines was observed. Since the hyperfine coupling constant for the ten-line spectrum is considerably smaller than those associated with the Nb^{4+} center, and since the measured g-value is greater than g_e, a hole in a niobium-oxygen unit is proposed as a tentative model for the ten-line spectrum. Gamma-irradiated lead borate glasses containing approximately 20 molar % PbO exhibited a five-line spectrum similar to that observed for alkali borate glasses. At about 35 molar % PbO, only a structureless asymmetric ESR spectrum was obtained. The same spectrum was observed in lead silicate glasses. Since the spectrum has no structure, and is observed in boron-free glass, the probable origin of the spectrum is a paramagnetic oxygen center located at an interstitial site. Among possible oxygen centers, the properties of the O^- center are most consistent with observed data. An O^- center near a Pb^{2+} ion is proposed as a tentative model for the origin of the spectrum. (Disser Abstr.)

30637 RADIATION CHEMISTRY OF GASEOUS AMMONIA. Carstensen, Jens Thuroe. Hoboken, N. J., Stevens Inst. of Tech., 1967. 151p.

Thesis.

An extensive study of the γ-radiolysis of NH_3 is reported, which substantiates a detailed reaction mechanism and throws a new light on the general mechanism. Aside from excitation and ionization, the occurrence of NH_4^+ was previously demonstrated, but the data reported here, in conjunction with energetic requirements and with recently published mass spectrometry data makes the inclusion of NH_2^+ a necessity. The primary acts may be summarized as: $NH_3 \rightsquigarrow NH_3^*$, $NH_3 \rightsquigarrow NH_3^+ + e$, and $NH_3 \rightsquigarrow NH_2^+ + H + e$. The eventual formation of H_2 and N_2 is postulated by a sequence of reactions, supported by the findings of this investigation. Several reaction schemes previously thought probable are ruled out here on experimental evidence. Scavenging experiments led to determination of a previously unreported rate constant, viz. the rate constant for the gas phase reaction: $H + CH_3OH \rightarrow H_2 + CH_2OH$. The rate constant at 25°C is $k = 10^6$ cc/mole-sec. (Disser. Abstr.)

30638 STORAGE AND STABILITY OF COMPOUNDS LABELLED WITH RADIOISOTOPES. Bayly, R. J.; Evans, E. A. RCC Review 7. Amersham, England, The Radiochemical Centre, 1968. 80p.

Radioisotope labeled compounds decompose on storage, a process which is accelerated by self-irradiation. Present knowledge of this decomposition is reviewed, together with measures which can be taken to control and minimize the rate of self-radiolysis. Tables are given showing observed amounts of decomposition for a considerable number of compounds, labeled with various isotopes and stored under various conditions. (U.K.)

30639 GAMMA-RAY RADIOLYSIS OF PENTABORANE-9 IN THE GAS PHASE. Pinson, James Wesley. University, Miss., Univ. of Mississippi, 1967. 187p.

Thesis.

Pentaborane-9 was irradiated in the gas phase with ^{60}Co γ radiation. The gaseous products obtained were H_2, diborane, and tetraborane-10 as well as nonvolatile and volatile solid fraction. The volatile solid fraction was identified as decaborane-16 by physical properties, infrared, and mass spectrometry. The nonvolatile solid fraction was analyzed by infrared and mass spectrometry. The results indicated the solid was hydrolytic in moist air and contained a variety of B–H and B–B bonds. For the combined solid a mass range of 109 to 123 mass units was obtained. The central mass unit, 116, was used in subsequent calculations. The radiolysis was studied as functions of time, pressure, radical scavenger, and temperature. The production of products was shown to proceed as a function of irradiation time through three distinct regions over the pentaborane-9 pressure range of 10 to 160 torr. The initial region showed a first-order kinetic dependence for H_2 and diborane production and a predominantly ionic-type mechanism. The second region also obeyed first-order kinetics, but with a factor of two reduction in the rate constants. Free radical processes were more dominant in this region. The third region showed the typical linear dependence of G values with irradiation time. A steady state between ionic and free radical mechanisms was reached in this third region with free radical mechanisms contributing 41% of the yield as indicated by scavenger experiments. Radiolysis of pentaborane-9 vapor as a function of pressure revealed a pressure-independent region between 107 and 160 torr and a marked increase in the G value of the products in going from 107 down to 10 torr. Calculations of the pentaborane-9 rate of decomposition and the polymer rate of production were carried out using the concept of mass balance in the system, the experimental results of boron-hydrogen determinations of the solid polymer, mass spectra, and the rate constants for the products over the three time regions. Concentrations and G values were tabulated over the pentaborane-9 pressure range of 10 to 160 torr and the three regions of time dependence at each pressure. Fortran II D computer programs included in the appendixes were used to facilitate such tabulations. Temperature dependence experiments were conducted at 32, 39.5, and 46.5°C. Time dependence regions one and two were found to shorten in time as the temperature increased. Activation energies for product production were obtained and related to proposed mechanisms for product production. Mechanisms based on the time dependence, pressure dependence, scavenger results, and temperature dependence were proposed and tested using kinetic analysis. The calculated rate law for the decrease of pentaborane-9 agreed well with the decrease rate obtained from experimental data. (Disser. Abstr.)

30640 EPR STUDIES OF TRAPPED ELECTRONS, HYDROGEN ATOMS, AND FREE RADICALS IN IRRADIATED SOLIDS. Zimbrick, John David. Manhattan, Kan., Univ. of Kansas, 1967. 228p.

Thesis.

EPR experiments were carried out to elucidate the physical and spatial properties of trapped electrons, hydrogen atoms, and free radicals. The relative yield of trapped electrons was measured by EPR methods as a function of ^{60}Co γ dose in 6.0 and 10.0$\underline{M}$ glassy phase NaOH ice at 77°K. Paramagnetic relaxation times of trapped electrons were measured in 10.0$\underline{M}$ glassy NaOH ice as a function of radiation dose, temperature, and deuterium substitution. Relaxation times were measured for H and D atoms in glassy 8.7$\underline{M}$ H_2SO_4 and 10.9$\underline{M}$ H_3PO_4 ices at 77°K as a function of radiation dose. Similar measurements were made on: H atoms trapped in polycrystalline ices that contained oxyanion salt solutes such as NaH_2PO_4 and $NaHSO_4$; and free radicals trapped in ethylene glycol dimethacrylate monomer gels (EDMAX). Spin-spin and spin-lattice relaxation times were obtained by measuring the power saturation characteristics of the EPR absorption line under conditions of "slow" and "fast" passage magnetic field modulation as treated theoretically by Portis and Castner. The relative yield of trapped electrons in glassy alkaline ices at 77°K increased linearly with increasing ^{60}Co γ radiation dose in the range 0 to 2 MRAD. The yield saturates at about 2 MRAD and then decreases at higher doses. The relaxation times for this species remain constant at about 2×10^{-5} sec over a radiation dose range of 0.3 MRAD to 2 MRAD. Between 2 MRAD and 5 MRAD the relaxation time decreases to about 1×10^{-5} sec. This behavior is different from that obtained for trapped H and D atoms in H_3PO_4 and H_2SO_4 glassy ices. The relaxation times for H atoms and D atoms are the same within limits of experimental error for any given radiation dose and decrease from about 5×10^{-5} sec at 0.5 MRAD to 1.2×10^{-5} sec at 16 MRAD. The relaxation time decreases with increasing dose in the same dose region in which the yield of H and D atoms is increasing. The relaxation time of H atoms trapped in polycrystalline oxyanion solute ices varies with the type of solute. The relaxation time of free radicals in EDMA monomer gels at room temperature remains constant at 3×10^{-6} sec over a radiation dose range of 0.5 MRAD to 2 MRAD. The spin-spin relaxation time increases when the temperature is changed from 298 to 77°K. The following conclusions are drawn: electrons in alkaline ices are trapped in hydroxyl anion vacancies and have a nonuniform spatial distribution caused by the distribution of vacancies within radiation-produced spurs of 20 to 30 Å radius; the electron trap is analogous to an F-center trap in an alkali-halide crystal. At high radiation doses paired electrons are produced which are analogous to F′-centers; H atoms and D atoms are trapped in spatially uniform interstitial positions near oxyanions and are not trapped within "spurs"; the relaxation time of H atoms is shorter in polycrystalline oxyanion ices than in glassy acidic ices and may be caused by a difference in potential energy well depth of the trapping sites in these two different phases; radiation-produced free radicals in EDMA gels are the same species as those found in methyl methacrylate gels. The EDMA radicals are trapped within "spurs." (Disser. Abstr.)

30641 ESR STUDIES OF FREE RADICALS FORMED BY AUTORADIOLYSIS OF RADIOACTIVE LABELLED ORGANIC COMPOUNDS. Lassmann, G. (Inst. of Biophysics, Berlin). pp 788-95 of Magnetic Resonance and Relaxation. Blinc, R. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From International Conference on Magnetic Resonance and Relaxation, 14th Colloque AMPERE, Ljubljana, Yugoslavia. See CONF-660924.

The formation of free radicals in tritium-labeled solid amino acids and dicarboxylic acids by self-decomposition was studied by ESR. ESR spectra from succinic acid labeled with tritium in different positions (CH or OH) were recorded at room temperature and at 90°K and the spectra did not exhibit any typical differences at different labeling positions. Furthermore the number of registered radicals in all substances under investigation was greater at least by a factor of fifty than the number of tritium β decays occurring within the same time interval. Consequently the recorded radicals in tritium-labeled organic compounds do not result from the separation of helium from the molecule but are almost exclusively due to internal irradiation with slow β electrons. ESR spectra from internal β-irradiated amino acids and dicarboxylic acids are compared with those after external x- or γ-irradiation and in most substances the spectra coincide, showing that in this case the same radicals are formed. However, the ESR spectrum of irradiated succinic acid shows two radicals with different lifetimes. Components of spectra belonging to the short lived species in β-irradiated samples disappear during the long irradiation time (10^6 rad within 1 month). In ^{3}H-labeled L-leucine the ESR spectrum is quite different than after x- or γ-irradiation. Using low-temperature irradiation this change of spectrum was interpreted as a complete conversion of a short-lived unstable primary radical into a more stable secondary type during storage. The kinetics of primarily formed radiolytic radicals were studied. After a low-temperature radiolysis of tritiated L-leucine, DL-alanine, L-glutamic acid, succinic acid, and fumaric acid the samples were warmed by 20° for several minutes, cooled again to 90°K, the spectrum registered, annealing continued, etc. The ESR spectra obtained at the end of the annealing agreed as to the number and splitting of components with those recorded after room temperature irradiation. Without precisely knowing the radical structure it was found that ESR spectra measured at 90°K after low-temperature radiolysis are due to direct radical precursors of stable final radicals recorded at room temperature. The irreversible spectra change interpreted as a radical conversion is most pronounced in the region from −100 to −40°C and is generally accompanied by a more or less strong drop of spin concentration, i.e., recombination occurs. These processes proceed during room-temperature irradiation in a very short time and are observable with ESR only by trapping of primary species at low temperature. (auth)

Radiochemistry

Refer also to abstract 30612.

30642 METHODS FOR MEASURING ^{125}I ACTIVITY. Erdelyvari, Istvan; Feher, Istvan (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). Magy. Kem. Foly., 74: 99-103(Mar. 1968). (In Hungarian).

Methods developed for the standardization of ^{125}I to ±2% accuracy, for the measurement of high specific activity samples with ±5% accuracy, and for radiation protection control in connection with the application of ^{125}I are described. The measuring methods, based mainly on the use of Hungarian instruments, were successfully applied in the production of ^{125}I. (auth)

30643 EVALUATION OF THE ABSORBED DOSE DURING USE OF THE EMANATION METHOD. Bekman, I. N.; Zaborenko, K. B. Radiokhimiya, 10: 124-8(1968). (In Russian).

The dose absorbed by solids containing thorium isotopes (homogeneous and surface distribution) in quantities required for the use of the emanation method was calculated. The density and the probability of overlapping of thermal peaks were evaluated. The rate of accumulation of radiation defects in ThO_2 was determined, and the degree of union of the surface layers of polyethylene was calculated. (tr-auth)

Separation Processes

Refer also to abstracts 30552, 30554, 30570, 30576, 30784, 31065, and 31114.

30644 (AAEC/E-189) DEVELOPMENT OF SOLVENT EXTRACTION PROCESSES FOR THE H.T.G.C.R. FUEL CYCLE. PART 3. CHEMICAL DATA FOR THE EXTRACTION OF ACTINIDES AND FISSION PRODUCTS FROM AQUEOUS BERYLLIUM SULPHATE SOLUTIONS USING AMINES. Fardy, J. J.; Farrell, M. S.; Pinchbeck, D. G. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jan. 1968. 44p. Dep.

Chemical data are presented for the actinides (uranium, plutonium, and thorium), fission products (cerium, zirconium, niobium, and ruthenium) and beryllium in the extraction of these from beryllium sulfate solutions by amines, in particular Primene-JMT and Alamine-336. The data define the major chemical parameters requiring control in a solvent extraction process to decontaminate beryllium sulfate, and indicate that use of the solvent Primene-JMT/Solvesso-100 will adequately remove the uranium, thorium, plutonium, cerium, zirconium, and niobium without extracting significant quantities of beryllium. Ruthenium is not highly extractable and strontium and cesium are extractable only in trace quantity. Although this process will be adequate for primary decontamination of the beryllium sulfate, a further step to remove residual ruthenium, strontium, and cesium may be required. The actinides with the extracted fission products are readily stripped from the amine phase with nitric acid, thus permitting recovery of the actinides by a conventional tributyl phosphate process. The amine phase is readily converted back to the free-base form using sodium carbonate. This is necessary to prevent recycling of the nitrate, which would inhibit the extraction of thorium, plutonium, and fission products. (auth)

30645 (CONF-670965-1) LE TRAITEMENT DES DECHETS SOLIDES FAIBLEMENT RADIOACTIFS DE L'ETABLISSEMENT DU C.C.R. EURATOM A ISPRA. (Treatment of Weakly Radioactive Solid Waste at the C.C.R. Euratom Facility at Ispra). Mosselmans, G. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Sept. 1967. 23p. (In French). Dep.

From 13th Conference on Sanitary Physics, Ispra, Italy.

The Ispra installation is located in a region with dense population. For this reason the processing of radioactive waste is a necessity which implies the use of elaborate, precise, and costly methods. Moreover, the treatment itself should be specific for each type of waste. The solid residues are sorted into compressible and noncompressible wastes. They are then subjected to appropriate treatments as a function of their respective category: reduction of dimensions, compression before finally stabilizing them in asphalt. These various processing steps require specific installations, which are described. The study of the processing cost was done according to the IAEA method for cost analysis and is given for the first six months of 1967. (tr-auth)

30646 (EURFNR-460) BEHAVIOR OF HIGH PLUTONIUM CONCENTRATIONS IN PUREX PROCESS AND DEVELOPMENT OF FAST SEPARATORS FOR THE REPROCESSING OF NUCLEAR FUELS: CONTRIBUTIONS TO THE FORATOM MEETING HELD IN CONNECTION WITH ACHEMA, 1967. Baumgaertner, F.; Ochsenfeld, W.; Roth, B.; Finsterwalder, L. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Heisse Chemie). Translation of report KFK-652. 28p. (EUR-3683). Dep. CFSTI.

Work performed under United States–Euratom Fast Reactor Exchange Program.

The first chemical problem posed by Purex reprocessing of high-Pu-content fuel is the recessive extraction behavior of the Pu–TBP–uranyl nitrate system. Two fast separator types were built and tested: the hydrocyclone separator and the compact centrifuge. (M.C.G.)

30647 (EURAEC-1694) RETRAITEMENT DU COMBUSTIBLE IRRADIE PAR VOLATILISATION. REGENERATION DE COMBUSTIBLES CERAMIQUES. Rapport Final. (Reprocessing of Irradiated Fuel by Volatilization. Recovery of Ceramic Fuels. Final Report). (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). 1967. Contract 004-64-4-RCIB. 130p. (In French). (EUR-2882). Dep. CFSTI.

Work Performed under United States–Euratom Joint Research and Development Program.

Both chlorine trifluoride and fluorine can be used for the reprocessing of ceramic fuel in mixed-oxide form $(U, Pu)O_2$. The former, apart from its ability to convert the compact uranium dioxide directly into hexafluoride, also reacts with powdery fuel. In none of the technological experiments carried out did it give rise to caking of the powders. Chlorine trifluoride is therefore a reagent that lends itself well to the various forms the fuel may assume after irradiation and decladding. Valuable technological data were obtained concerning a reaction scheme in which fluorine was used for the simultaneous volatilization of uranium and plutonium. A hot semi-pilot plant for evaluation of these two reprocessing cycles is under construction. A series of experiments was undertaken with the aim of facilitating the operation or increasing the safety of this plant. Research was conducted on the pulverization conditions for uranium carbide with a view to the subsequent formation of hexafluoride. Also the direct reaction between uranium monocarbide and chlorine trifluoride was investigated. The problem of converting uranium and plutonium fluorides into oxides was examined. (auth)

30648 (NP-17366) SHORT RESIDENCE EXTRACTORS. A Review of Their Characteristics and Performances in Nuclear Fuel Reprocessing. Centeno, J.; De Witte, R. (European Company for the Chemical Processing of Irradiated Fuels, Mol (Belgium)). Mar. 1967. 28p. (ETR-191). Dep.

One of the difficulties encountered in the aqueous reprocessing of high-burnup fuels is the high radiolytical degradation of the solvent used (TBP-kerosene) as extractant in the first decontamination cycle. Different types of short-residence extractors, which can be regarded as possible solutions for decreasing the radiolytical degradation of the solvent, are briefly described and analyzed according to their construction and operational characteristics. The usefulness of short-residence extractors for recovery and separation of fission products is also pointed out. It is suggested that an experimental program be started in order to gain experience in this field and to be in a position to face this problem of radiolytical degradation from the technological side. (auth)

30649 (NP-17368) AQUEOUS REPROCESSING IN A MULTIPURPOSE PLANT. Barendregt, T. J.; Detilleux, E.; Rometsch, R. (European Company for the Chemical Processing of Irradiated Fuels, Mol (Belgium)). Nov. 1967. 38p. (ETR-210; CONF-671103-5). Dep.

From 60th Annual Meeting of the American Institute of Chemical Engineers, New York.

A brief outline of the reasons for establishing Eurochemic and the aims of the Company are given. This is followed by a description of the plant design and layout and the choice of process, chemical rather than mechanical. The methods used for accurate accountability of fissile material and for maintaining the required nuclear safety level are dealt with and the experience gained during the first year of operation (from June 1966) summarized. (auth)

30650 (NP-17459) COLUMN FLOTATION OF URANIUM FROM ELLIOT LAKE ORE. Technical Bulletin TB-96. Honeywell, W. R. (Department of Energy, Mines and Resources, Ottawa (Ontario). Mines Branch). Dec. 1967. 13p. CAN $0.50.

Studies were made on the column flotation cell on an Elliot Lake ore sample. Results obtained from conducting exploratory tests followed by a statistically designed series of tests involving six operating variables using a two-inch-diameter column cell are given. On deslimed uranium ore, a recovery of 90% with a concentration ratio of 3.0 was obtained. These results are similar to those obtained using conventional cells in previous studies. On undeslimed ore, recoveries in the order of 80%, and concentration ratios ranging from 4.7 to 8.3 were made. These concentration ratios were higher than can be obtained by conventional cells, but the recoveries were lower. (auth)

30651 (UCRL-Trans-10243) HYDROLYSIS OF TETRAVALENT PROTACTINIUM. Guillaumont, Robert. Translated by Z. F. St-Gallay for Univ. of California Lawrence Radiation Lab., Livermore, from Compt. Rend., 260: 1416-18(1965). 10p. Dep. CFSTI.

This paper was previously abstracted from the original language and appeared as NSA 19: 20063. (auth)

30652 SEPARATING SALTS HAVING INVERTED SOLUBILITY CURVES. Hatch, L. P. (to United States Atomic Energy Commission). U. S. Patent 3,390,078. June 25, 1968.

A process is described for heating saline solutions containing salts having inverted solubility curves to temperatures above 260°F. The saline solution flows upward through a walled heat exchanger having heating means contained in the walls while maintaining a bed of particles in a fluidized state with the upward flow of the water. The fluidized particles are in contact with the walls of the exchanger. (AEC)

30653 PROCESS FOR THE PURIFICATION OF TERPHENYL AND/OR ANALOGOUS ORGANIC MATERIALS. Imarisio, Giancarlo (to EURATOM). British Patent 1,112,691. May 8, 1968. Filed Aug. 17, 1965.

Terphenyl and/or analogous organic materials can be purified by circulation through a bed of Zr and/or Ti or an alloy(s) of these at a temperature between 300 and 450°C. The metal or alloy may be in the form of chips, turnings, grains, or sheets. (B.L.M.)

30654 LIQUID-LIQUID CONTACTING APPARATUS. Hebden, Donald; Mills, Alfred Leonard (to United Kingdom Atomic Energy Authority). British Patent 1,114,591. May 22, 1968. Filed May 3, 1965.

A mixer-settler liquid-liquid contacting apparatus is made up of a vessel having transverse and longitudinal walls defining a series of cavities and a support member carrying a number of elements each insertable in one of the cavities. Each element effectively defines a mixer compartment and an associated settler compartment. The mixer compartment has upper and lower inlet ports and a mixer phase outlet port communicating with the associated settler compartment, which has overflow and underflow weirs. The vessel wall has a first set of passageways for heavy phase flow from the underflow weirs to the lower inlet ports and a second set of passageways for light phase flow from the overflow weirs to the upper inlet ports. (B.L.M.)

30655 APPLICATIONS OF LIQUID-LIQUID EXTRACTION TO THE TREATMENT OF IRRADIATED FUELS. PART 2. TECHNOLOGICAL ASPECTS. Detilleux, E.; Centeno, J. Ind. Chim. Belge, 775-90(1967). (In French).

The application of liquid-liquid extraction techniques to the treatment of irradiated fuels is analyzed. The technological problems to be resolved in order to satisfy the requirements of the chemical flowsheet designed are discussed. The various types of contacters used in the nuclear industry are reviewed. The particular solutions imposed by the manipulation of highly radioactive solutions are emphasized. (tr-auth)

30656 IMPROVEMENTS IN PROCESSES FOR SIMULTANEOUSLY PURIFYING AND CONCENTRATING PLUTONIUM SOLUTIONS. Boudry, Jean Claude; Chambon, Marcel; Faugeras, Pierre; Lheureux, Colette; Talmont, Xavier (to Commissariat a l'Energie Atomique). British Patent 1,113,237. May 8, 1968. Priority date June 19, 1964, France.

A continuous extraction process is described for the simultaneous purification and concentration of Pu from its aqueous solutions in a single operation. The aqueous solution of Pu, having a sulfate content of <0.2$\underline{M}$ is subjected to countercurrent extraction with a flow of organic phase containing TBP. The organic phase is contacted in a counter current flow with a uranous nitrate solution to reduce the Pu to the trivalent state and is further contacted in countercurrent flow with a hydrazine solution in HNO_3 to obtain a concentrated Pu raffinate. A portion of the Pu raffinate is reoxidized and recirculated back into the first extraction step along with the starting aqueous solution. Preferably, the TBP phase is scrubbed with a countercurrent flow of aqueous HNO_3 prior to reduction of the Pu in the second step of the process. (B.L.M.)

30657 METHOD FOR THE EXTRACTION OF MATERIALS EMBEDDED IN A GRAPHITE BODY. Bildstein, Hubert; Knotik, Karl; Stolba, Gerhard (to Oesterreichische Studiengesellschaft fuer Atomenergie GmbH). British Patent 1,114,664. May 22, 1968. Priority date July 2, 1965, Austria.

A method for the removal of embedded materials, especially U and Th, from bodies of graphite consists of heating the graphite body and subjecting it to the action of the vapor of one or more halogens or halogen compounds so that the graphite body disintegrates and the embedded particles of materials can be removed. The graphite body is heated to a temperature of 2500 to 3000°C so that the coatings burst open. (B.L.M.)

30658 PROCESS FOR ISOTOPE CONCENTRATION. Glew, David Neville (to Dow Chemical Co.). British Patent 1,113,215. May 8, 1968. Filed Sept. 23, 1965.

A process is described for concentrating D in H_2O by enriching with D a H-containing compound capable of forming a solid hydrate at temperatures not exceeding 30°C. The compound is contacted with D-containing H_2O at a temperature of at least 50°C for a time sufficient to obtain exchange of the H of the compound and the D in the H_2O. The D-enriched compound is separated from the D-depleted H_2O, and the D-enriched compound is contacted with an aqueous medium with normal or enriched D content at a temperature between 30 and -60°C so as to form a solid hydrate, which is separated from the liquid phase. The separated solid hydrate is decomposed to release hydration water enriched in D content which is separated from the D-depleted hydrate forming compound. (B.L.M.)

30659 PRACTICES IN THE TREATMENT OF RADIOACTIVE WASTES IN THE FEDERAL REPUBLIC OF GERMANY. Schulze-Rettmer, R. (Kernforschungsanlage, Juelich, Ger.). Vom Wasser, 33: 211-28(1966). (In German).

In the Federal Republic of Germany there are 34 nuclear reactors in operation or under construction plus numerous users of radioisotopes in industry and medicine and processing installations for nuclear fuels. Each of these installations yields radioactive wastes. The characteristics of these wastes are summarized with respect to the installation of origin. The most common practices in the collection and treatment of radioactive wastes currently used in the Federal Republic are outlined. The treatment of concentrate-end precipitate is described. The cost of the waste processing is evaluated. (J.S.R.)

30660 ANALYTICAL CHEMISTRY OF BENZILIC ACID. Gupta, S. S.; Mukerjee, D. (Lucknow Univ., India). Z. Anal. Chem., 233: 20-5(1968).

Sodium benzilate is a very versatile reagent as it precipitates a large number of metal ions, most of them quantitatively. The composition of the precipitates and conditions for their quantitative precipitation were found out. A proper use of the reagent was made by co-precipitating metals like zinc, lead, and silver, then separating them by organic solvents. (auth)

30661 COMPLEX FORMATION OF PROTACTINIUM WITH THENOLYTRIFLUOROACETONE IN PERCHLORATE SOLUTIONS. D'yachkova, R. A.; Khlebnikov, V. P.; Spitsyn, V. I. Zh. Neorg. Khim., 13: 836-41(Mar. 1968). (In Russian).

The extraction of Pa with solutions of thenoyltrifluoroacetone in benzene from perchlorate medium at $\mu = 1$ was investigated. On the basis of the study of the dependence of Pa on $[H^+]$, $[A^-]$, and [HA], it was established that Pa is extracted in the form of a complex with the composition $MA_2(HA)_2$, and in the aqueous phase the compounds MA^+ and MA_2 are formed, where M^{2+} represents the two-valent, hydrolyzed ion of Pa. The stability constants of the complexes MA^+ and MA_2 were calculated as $\beta_1 = 1.97 \times 10^8$, $\beta_2 = 2.75 \times 10^{15}$ by the two-parameter method and $\beta_1 = 1.55 \times 10^8$, $\beta_2 = 0.95 \times 10^{15}$ by the Bjerrum method. The reaction mechanism for the extraction of Pa by thenoyltrifluoracetone was proposed as $M^{2+}_{aq} + 4HA_{aq} \rightleftharpoons MA_2(HA)_{2\ org} + 2H^+_{aq}$. The equilibrium constants for this reaction were calculated. (tr-auth)

30662 COMPLEXES OF HYDRAZINE-DI-ACETIC ACID WITH RARE EARTHS. APPLICATION TO THE SEPARATIONS BY ION EXCHANGE. Minn, Oon Kyoung; Loriers, Jean (CNRS, Bellevue, France). Compt. Rend., Ser. C, 266: 618-21(Feb. 26, 1968). (In French).

Hydrazinediacetic acid (HDA) forms stable complexes with the Ln^{3+} ions of the rare earths and yttrium in slightly acid or basic medium. The titration curves show the existence of the complexes 1 HDA + 1 Ln, 2HDA + 1 Ln, and 3 HDA + 1 Ln, in which the regions of existence are in higher and higher pH zones. The differences in the stability of these complexes in the lanthanide series and the particular behavior of Y make it possible to separate them efficiently on ion exchange cation resin columns. Interesting results were obtained with solutions to 0.5% HDA in the separation of mixtures of ceric earths (La + Pr + Nd), yttrium earths (Gd + Tb + Dy + Ho + Er), and in the purification of Y. (tr-auth)

30663 DETERGENTS AND THE TREATMENT OF CONTAMINATED WATERS. Argiero, L.; Paggi, A. (Univ., Pisa, Italy). Health Phys., 14: 581-92(June 1968). (In French).

A study was made of the influence of surfactants in the treatment of contaminated waters, both in the flocculation and in the ion flotation processes. Data are given on the effect of varying the pH and the electrostatic charge of suspended particles. Some flocculation value and volume reduction factors are given for various cationic and anionic detergents. A relationship was found between pH, intrinsic viscosity, and efficiency of decontamination for ^{137}Cs in the ion flotation method. (auth) (UK)

30664 FLUIDIZED-BED FLUORIDE VOLATILITY PROCESSING OF IRRADIATED UO_2 FUELS. Chilenskas, A. A. (Argonne National Lab., Ill.). Nucl. Appl., 5: 11-19(July 1968).

In five laboratory-scale experiments in which irradiated UO_2 reactor fuel was processed in a fluidized bed, high removals of uranium and plutonium were achieved by oxidizing with O_2, fluorinating with BrF_5 to convert uranium to volatile UF_6, then fluorinating with F_2 to convert plutonium to volatile PuF_6. The principal activities volatilized during the oxidation step were ~27% of the krypton and ~3.5% of the ruthenium. During the uranium separation step, >99.5% of the uranium and <0.5% of the plutonium volatilized with ~60% of the ruthenium, ~67% of the krypton, ~76% of the molybdenum, and ~2.7% of the antimony. During the F_2 step, the principal activities that volatilized concurrently with the plutonium were ~38% of the molybdenum, ~8% of the ruthenium, ~0.2% of the zirconium, ~5.8% of the niobium, ~1% of the antimony, and ~5% of the krypton. Analyses for tellurium, technetium, and neptunium, which are other possible contaminants in the uranium and plutonium stream, were not completed. (auth)

30665 GAS SORPTION-DESORPTION METHOD FOR RECOVERING PLUTONIUM HEXAFLUORIDE. Katz, Sidney; Cathers, George I. (Oak Ridge National Lab., Tenn.). Nucl. Appl., 5: 5-10(July 1968). (ORNL-P-3693).

In the search for an efficient sorption-desorption system for recovering and purifying plutonium hexafluoride, 31 candidate metal fluorides were tested. Of these, the fluorides of the IA and IIA metals were found to react (or sorb) most favorably and were therefore selected for further study. Results of extensive tests, in which the sorption and desorption capabilities of these more promising fluorides were considered, indicated that only lithium fluoride was effective in both respects. A chemical equilibrium was found to exist between plutonium hexafluoride, fluorine, lithium fluoride, and a complex (probably Li_4PuF_8) containing Pu(IV). The sorption of plutonium hexafluoride was much improved as the surface area of the lithium fluoride was increased. Plutonium hexafluoride containing no detectable uranium hexafluoride was obtained from a mixture by a sorption-desorption separation. (auth)

30666 RECOMMENDATIONS FOR THE ASSESSMENT OF SURFACE MATERIALS FOR USE IN RADIOACTIVE AREAS. PART 1. METHOD OF TEST FOR EASE OF DECONTAMINATION. British Standard 4247, Part 1, 1967. London, British Standards Institution, 1967. 8p. 5s.

A standard test is recommended, which was developed for comparison purposes, so that ease of decontamination of different surfaces can be compared, representing a first stage in the preparation of recommendations for the selection of surface materials for use in areas liable to contamination by radioactive substances. The method involves contamination of the surface with a solution of radiocaesium and radiocobalt, followed by a two-stage decontamination procedure. Decontaminating solutions comprise (1) sodium tripolyphosphate, EDTA, sodium di(2-ethylhexyl) sulphosuccinate, sodium carboxymethyl cellulose, and sodium hydroxide; (2) disodium EDTA, sodium di(2-ethylhexyl), sulphosuccinate, and sodium hydroxide. The contaminated area is washed consecutively with these two solutions, followed by distilled water. (UK)

30667 SUPPRESSION OF RADIOIODINE RELEASES FROM A RADIOCHEMICAL SEPARATIONS PLANT. Smith, S. R. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Nucl. Appl., 5: 20-3(July 1968).

In the Purex process used at the Savannah River Plant, the suppression of the release of radioiodine by complexing it with mercury was tested. Suppressing radioiodine release would be desirable if short-cooled fuel were inadvertently charged to the dissolver in the plant. When irradiated uranium reactor fuels are processed, radioiodine is normally evolved during dissolution with HNO_3, clarification, subsequent solvent extraction, and waste evaporation. Normally (without mercury), ~50% of the radioiodine is evolved from the dissolver solution and efficiently sorbed in a silver nitrate bed, but the small amount evolved from the remainder of the process is released to the atmosphere through tall stacks. This release is suppressed by adding mercuric nitrate to the dissolver solution. With $0.04\underline{M}$ Hg^{2+} in the dissolver solution and a gelatin clarifier, the radioiodine atmospheric release was reduced 55-fold. A material balance indicated that the mercury-iodine complex remained in the organic solvent where it was slowly removed by solvent scrubbers and subsequently transferred to a seepage basin. In another test, the presence of $5 \times 10^{-4}\underline{M}$ Hg^{2+} in the dissolver and the use of a MnO_2 clarifier reduced ^{131}I atmospheric releases a total of 22-fold. In tests without Hg^{2+}, MnO_2 clarification reduced ^{131}I atmospheric releases 2.5-fold over the normal gelatin clarification. Mercurous nitrate ($4 \times 10^{-4}\underline{M}$) was not more effective than mercuric nitrate ($5 \times 10^{-4}\underline{M}$) in suppressing ^{131}I evolution. (auth)

30668 SELECTIVE CATION EXCHANGE SEPARATION OF CARRIER-FREE ^{137}Cs AND ^{22}Na. Korkisch, Johann; Orlandini, K. A. (Argonne National Lab., Ill.). Anal. Chem., 40: 1127-30(June 1968).

From organic solvent media containing 2-thenoyltrifluoroacetone and pyridine, alkali metal ions such as cesium and sodium are strongly retained on the strongly acidic cation exchange resin, Dowex 50, while practically all other elements are not adsorbed under these conditions. This fact has been employed for the rapid and selective separation of cesium-137 from uranium fission products and of sodium-22 from deuteron-irradiated magnesium targets. The recovery of these two carrier-free radionuclides was found to be higher than 99.9% and their radiochemical purity was in the vicinity of 100%. An entire ion exchange separation such as the separation of cesium-137 can be completed in less than 3-4 hours. (auth)

30669 THEORETICAL CONSIDERATIONS ON THE ELECTROLYTIC SEPARATION OF URANIUM AND PLUTONIUM IN MOLTEN SALTS. Speeckaert, Ph. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). pp 195-201 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968. (In French).

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

A method of separating uranium and plutonium fluoride in eutectic LiCl-KCl is described. The purpose is to perfect separation of the uranium and plutonium obtained at the end of the fluoride volatilization cycle and to obtain UO_2 of high purity, which can be directly used in the refabrication of nuclear fuels. The method consists in dissolving the mixture of the two fluorides in eutectic LiCl-KCl heated to 450°C. The solution is then oxidized to obtain soluble uranium oxyhalogenide and to precipitate plutonium in the form of insoluble PuO_2. UO_2 is deposited at the cathode by electrolysis. The residual PuO_2 is treated with hydrogen chloride, mixed if necessary with hydrogen, which renders it soluble in the form of $PuCl_3$. The plutonium metal can be recovered at another cathode by electrolysis at a higher potential. This new method has the advantage of involving techniques already used experimentally. The separation tests carried out on uranium and cerium (replacing plutonium) gave separation factors of 100. (auth)

30670 CONTINUOUS PRECIPITATION PROCESS FOR RECOVERING URANIUM AND/OR PLUTONIUM FROM SOLUTION.

Stevenson, David Gordon (to United Kingdom Atomic Energy Authority). U. S. Patent 3,372,999. Mar. 9, 1965. Priority date Mar. 20, 1964, Great Britain.

In a continuous process for the recovery of U and/or Pu from solutions, the acidic feed solution containing the U and/or Pu salt is fed into the precipitation zone, an aliphatic C_1 to C_5 monocarboxylic acid is added to complex and prevent the precipitation of other metal ions, and a base is added to precipitate the desired salts. The base should be an alkali metal hydroxide or ammonia. (B.L.M.)

30671 IMPROVEMENTS IN OR RELATING TO THE DECONTAMINATION OF RADIOACTIVELY CONTAMINATED WATER. Frank, Willy-Heinrich; Von Hagel, Guenter British Patent 1,111,906. May 1, 1968. Priority date Aug. 18, 1964, Germany.

A method for the decontamination of radioactive water consists of treating the water with a composition composed of a porous carrier material, such as sawdust, charcoal, or coke, impregnated with a ferro- and/or aluminosilicate. The mole ratio of the metal cations to silicate ions in the porous material is from 1 : 3 to 1 : 6. The pH of the aqueous suspension of the composition is from 4 to 10. (B.L.M.)

30672 THORIUM SEPARATION. Sherief, Mohamed Kamel Saad El-Din; Almasy, Andor British Patent 1,111,944. May 1, 1968. Priority date June 3, 1964, Hungary.

A process for the separation of Th from rare earths, including Ce(IV) and Y, consists of dissolving the materials in H_2SO_4, reacting the solution with a reducing agent to convert Ce(IV) to Ce(III), and passing the solution through a bed of cation exchange resin. The final solution should contain a concentration of H_2SO_4 of about 2$\underline{M}$. The Th passes through the resin as a complex anion and is virtually all through the resin before the rare earths appear in the effluent. (B.L.M.)

30673 REPROCESSING OF SPENT URANIUM FUEL BY MEANS OF CHLORINATION AND FRACTIONAL ABSORPTION BY BARIUM CHLORIDE. Ishihara, Takehiko; Hirano, Kenmei; Soga, Takeshi (to Japan Atomic Energy Research Inst.). U. S. Patent 3,372,998. Mar. 4, 1966. Priority date Mar. 18, 1965, Japan.

Spent U fuel from an atomic reactor is converted at about 600°C by reaction with a chlorine-bearing C compound free from H into gaseous chlorides of U, mainly the tetrachloride, and of fission products. Uranium tetrachloride is preferentially absorbed from the chlorine mixture on $BaCl_2$ with which it forms a stable compound below 583°C. The compound is decomposed by Cl_2 to volatile UCl_6. The UCl_6 decomposes spontaneously to the tetrachloride, which may be recycled for further purification. (Offic. Gaz.)

30674 COMPETITIVE EXTRACTION OF URANYL NITRATE AND NITRIC ACID BY TBP. Asano, Mitsuru. Tech. Rep. Eng. Res. Inst., Kyoto Univ., No. 138, 12p.(Mar. 1968).

The infrared spectra of uranyl nitrate and nitric acid extracted into TBP–CCl_4 have been investigated, and the competitive extraction of uranyl nitrate and nitric acid by TBP has been discussed. The extraction behavior of uranyl nitrate from aqueous nitric acid solution by TBP has been analyzed by the mathematical treatments with taking into account of the suppression of the extraction of uranyl nitrate by nitric acid extracted into TBP. From the maximum value of distribution coefficient of uranyl nitrate, the values of equilibrium constants for the extraction reactions of uranyl nitrate and nitric acid with TBP have been calculated to be 17 and 0.063, respectively. The same analytical method has been extended to the extractions of uranyl nitrate by many organophosphorus compounds from aqueous nitric acid solutions. (auth)

30675 EXTRACTION OF ALKALINE EARTH METALS FROM PERCHLORIC ACID SOLUTION WITH TRIBUTYL PHOSPHATE. Lapitskaya, E. V.; Gorbenko, F. P. Radiokhimiya, 10: 90-3 (1968). (In Russian).

The distribution of perchloric acid between the aqueous phase and the tributylphosphate phase was studied. It was found that perchloric acid passes to the organic phase in the form of the trisolvate ($HClO_4 \cdot 3TBP$). The maximum extraction of the acid (K_P greater than 3) was observed at concentrations of $HClO_4$ ~ 0.5$\underline{M}$. The extraction of the perchlorates of Ca, Sr, and Ba from perchloric acid solution with TBP was studied. It was found that the extraction proceeds in a wide interval of solution acidity, beginning at 0.05$\underline{M}$ and increasing with increase in the acid concentration in the solution. The alkaline earth metals are extracted from perchloric acid solutions with TBP with the form of complexes of the type $Me(ClO_4)_2 \cdot 4TBP$. The mean values of the calculated extraction constant of the dissociation of the perchlorate complexes in perchloric acid solution is equal to 0.5×10^{-2} for K, 1.4×10^{-2} for Sr, and 2.4×10^{-2} for Ba. (tr-auth)

30676 EXTRACTION WITH TRIBUTYL PHOSPHATE FROM HYDROCHLORIC ACID SOLUTIONS. I. CALCULATION OF THE DISTRIBUTION COEFFICIENT OF HYDROCHLORIC ACID. Lebin, V. I. Radiokhimiya, 10: 88-90(1968). (In Russian).

As a result of the assumption of the ideal of the organic phase and of the simultaneous formation of three solvates of HCl with TBP, a calculation was made of the distribution coefficient of hydrochloric acid between its aqueous solution with concentrations from 1.08 to 10.4$\underline{M}$ and the tributyl phosphate. The value of the extraction constant, previously determined for HCl solutions with concentration $\ll 4\underline{M}$, was used in the calculation. The calculated data differed from experimental data by 7.5% on an average. (tr-auth)

30677 SEPARATION OF POLONIUM AND TELLURIUM BY THE PAPER CHROMATOGRAPHY METHOD. Kirin, I. S.; Zaitsev, V. M. Radiokhimiya, 10: 42-6(1968). (In Russian).

Techniques for the effective separation of Po and Te by paper chromatography are proposed. The paper chromatography method was used for studying the state of microquantities of Po in nitric acid solutions. (tr-auth)

30678 SEPARATION OF PLUTONIUM FROM SOME ELEMENTS ON ZIRCONIUM PHOSPHATE SILICATE SORBENTS. Barsukova, K. V.; Rodionova, G. N. Radiokhimiya, 10: 86-7 (1968). (In Russian).

A zirconium phosphate silicate was synthesized and its exchange capacity was determined as 6.6 mg-equiv/g. A separation was carried out on this sorbent with indicator quantities of Pu, U, rare earths, and transplutonium elements. Separation was made of Pu and Fe in weight quantities with the ratio 1 : 100 and 1 : 10,000. (tr-auth)

30679 SEPARATION OF THORIUM AND RARE EARTH ELEMENTS DURING PRECIPITATION OF THORIUM HYDROXIDE. Novikov, A. I.; Pirogova, T. A. Radiokhimiya, 10: 1-6(1968). (In Russian).

It was found that the precipitation of thorium in the hydroxide reduction form in the presence of 2.5 $\underline{M}$ ammonium sulfate solution with slow reduction of the acidity of the medium makes it possible to separate large quantities of thorium from microgram quantities of rare earth elements. (tr-auth)

30680 ZIRCONIUM SORPTION FROM AQUEOUS-ORGANIC SOLUTION OF HYDROCHLORIC ACID BY THE KU-2 AND AV-17 ION EXCHANGERS. Belyavskaya, T. A.; Dobrushina, G. D. Vestn. Mosk. Univ., Ser. II. Khim., No. 2, 131-4(Mar.-Apr. 1968). (In Russian).

The addition of organic solvent to a zirconium hydrochloride solution was found to result in the change of the sorption of this element by cation exchanger as well as by anion exchanger. (auth)

30681 ISOTOPIC COMPOSITION ALONG A DIFFUSION CASCADE WITH A POSTIRRADIATION RECYCLE FLOW. EFFECT OF THE PRESENCE OF ^{236}U ON THE SEPARATIVE WORK. Gueron, Henri M.; Geller, Leonard (S. M. Stoller Associates, New York). Trans. Amer. Nucl. Soc., 11: 34-5(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30682 POTENTIAL FOR USING BLENDING TO UPGRADE REPROCESSED URANIUM. Goodman, E. I.; Walton, R. D. Jr. (United States Atomic Energy Commission, Washington, D. C.). Trans. Amer. Nucl. Soc., 11: 33(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30683 URANIUM FUELS PROCESSING. Fryar, R. M. (Kerr-McGee Oil Industries, Inc., Oklahoma City). Trans. Amer. Nucl. Soc., 11: 122(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30684 SEPARATION OF ^{90}Y FROM ^{90}Sr PREPARATIONS BY THE METHOD OF SORPTION ON GLASS POWDERS. Shchebetkovskii, V. N.; Egorov, Yu. M. Radiokhimiya, 10: 83-5(1968). (In Russian).

With the purpose of establishing conditions for the production of the maximum yield of ^{90}Y during separation from ^{90}Sr preparations, the optimum magnitudes of the sorption and desorption of microquantities of Y were first determined. The results showed that from solutions with pH = 6.1 to 6.2 microquantities of Y are quantitatively recovered with layers of glass powders in the presence of microconcentrations of Sr, Na, Ba, and Ca salts, at column heights of 30 mm. The optimum elution conditions were also determined. (J.S.R.)

30685 BACTERIAL LEACHING OF URANIUM. MacGregor, R. A. (Stanrock Uranium Mines, Ltd., Elliot Lake, Ont.). Trans. Amer. Nucl. Soc., 11: 123-4(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30686 MILLING TECHNOLOGY OF URANIUM ORES. Ross, Alvin H.; Guglielmin, Leonard G. (Ross and Associates, Toronto). Trans. Amer. Nucl. Soc., 11: 121-2(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30687 USE OF THE STRONGLY BASIC ANIONITE AV-17 FOR THE SEPARATION AND PURIFICATION OF THORIUM. Tikhomirov, V. K.; Petrukhin, N. V. Radiokhimiya, 10: 111-12(1968). (In Russian).

It was found that the capacity of thorium for the formation of negatively charged nitrate complexes can be used for the separation of microquantities of this element from solutions containing long-lived fission products and uranium, purification of ^{232}Th from daughter products, and for some other analytical and radiochemical purposes. The state exchange capacity of the strongly basic anionite AV-17 for ^{232}Th was determined in a $1\underline{N}$ HNO_3 medium. (tr-auth)

30688 SEPARATION OF SMALL QUANTITIES OF GOLD AND THALLIUM BY COPRECIPITATION OF THE LATTER WITH IRON HYDROXIDE. Novikov, A. I.; Pirogova, T. A. Radiokhimiya, 10: 82-3(1968). (In Russian).

A method is proposed for the separation of gold and thallium by the coprecipitation of Tl with iron hydroxide and separation of the Tl from the carrier. (tr-auth)

EARTH SCIENCES

Geology and Hydrology

Refer also to abstracts 30491, 30775, 30792, 30886, 31665, and 33184.

30689 (BNWL-728) A TEST SIMULATION OF THE TEMPERATURE OF THE ILLINOIS RIVER AND A PREDICTION OF THE EFFECTS OF DRESDEN II AND DRESDEN III REACTORS. Jaske, R. T. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 1968. Contract AT(45-1)-1830. 44p. Dep. CFSTI.

A digital simulation system was used to simulate and predict the effects of reactor operations on water temperature in the Illinois River. The COL HEAT simulation system was found to be generally adequate to represent the water temperature of the river within the accuracy of the available data. Sources of data and comparisons of computed and measured data are given. The study forecasts significant alteration of the thermal regime of the Illinois River due to the operation of the Dresden II and III reactors. Dresden I, already in operation, raises the annual average water temperature by 0.2 to 0.3°C, whereas the operation of the additional two reactors is expected to raise the water temperature by about 3.0°C. The COL HEAT simulation system is recommended for studying even larger, regional water systems. (L.C.L.)

30690 (IFA-IS-49) STUDY ON THE RADIOACTIVE CHARACTERISTICS OF SOME LEACHED CHERNOZEMS FROM THE SOCIALIST REPUBLIC OF ROMANIA. Szabo, Arpad; Treiber, I.; Balint, J.; Jakab, E.; Cordis, V. (Academia R. P. R., Bucharest. Institutul de Fizica Atomica). 1968. 18p. Dep.

Radiological analyses were made on eight leached chernozem from different pedogeographical regions of the Socialist Republic of Romania. It was established that the total beta radioactivity alters between restricted limits, presenting a slight decrease towards the inferior horizons. Correlations between the total radioactivity and the value of pH and T of the samples, respectively, with the contents of TiO_2 and ZrO_2, are presented in graphical form. In order to clarify the interdependence between the relation, Ra/Th and total radioactivity were analyzed radiochemically. Certain differences were noticed between these values, which are explained by the fact that in the total activities, besides the Ra and Th, other radioactive elements from the samples are also included. (auth)

30691 (ORNL-TM-2160) SURVEY OF POTENTIAL USE OF NUCLEAR ENERGY IN WASTE WATER TREATMENT. Schaffer, W. F. Jr.; Spiewak, I.; Blanco, R. E.; Boegly, W. J. Jr. (Oak Ridge National Lab., Tenn.). June 1968. Contract W-7405-eng-26. 61p. Dep. CFSTI.

A literature survey of waste water treatment processes was made to determine if low-cost nuclear energy, heat, radiation, or electricity, could be used to reduce the cost of waste water treatment. The greatest impact of cheap nuclear energy is expected in large waste treatment plants, 100 Mgd (million gallons per day) or greater, employing advanced treatment systems which produce water for recycle. Among the advanced unit processes which might benefit most are wet air oxidation of sewage or sludge (the cost of sludge processing might be reduced 6 to 25%, for example), chemical oxidation such as with ozone, sludge drying, electrolytic treatment of sewage, and removal of salts from waste (with distillation, membranes, etc.). An analysis of hypothetical advanced recycle systems of 100 to 200 Mgd capacity indicated water costs of 12 to 18¢ per 1000 gal. Such costs are not much greater than the cost of conventional water supply, treatment and waste treatment. Other literature estimates for recycle systems, on a smaller scale and with higher energy costs, totaled about 50¢/1000 gal. The analysis of hypothetical large recycle systems showed that a combination of seawater desalting and waste water reclamation was a more economical system for water supply for coastal cities than either method alone. As standards for permissible quality of waste discharge to steams are made more stringent, the quality of municipal waste will approach public health standards for water supply. Recycle of water is widely recognized as a necessary long-range objective, but, of U. S. cities surveyed, only Los Angeles is seriously considering recycle at present. (auth)

30692 (PNE-5008) DISTRIBUTION OF SELECTED TRACE ELEMENTS IN ROCKS. Kley, Ronald J. (Army Engineer Nuclear Cratering Group, Livermore, Calif.). Feb. 27, 1968. Contract W-7405-eng-48. 68p. Dep. CFSTI.

Factors influencing trace element distribution in rocks, tables of maximum and minimum concentrations of twenty-nine trace elements in various common rock types, and descriptions of the geochemical behavior of each of these elements are presented. A procedure is outlined for predicting concentrations of these selected elements in various rock types. Trace element concentration varies systematically according to the gross mineralogical composition of the host rock. Mineralogical composition of the host rock is the primary determinant of trace element concentrations. Knowledge of rock mineralogy as provided by conventional petrographic analyses serves as a basis for estimating trace element concentrations. (auth)

30693 USE OF GAMMA-NEUTRON REACTION FOR DETERMINING D_2O IN H_2O AND IN TRACING SOIL MOISTURE. Overman, Robert F.; Corey, John C.; Hawkins, Richard H. (E. I. duPont de Nemours and Co., Aiken, S. C.). Trans. Amer. Nucl. Soc., 11: 74(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30694 RADIOACTIVE TIME SCALE. Brandt, S. B. Priroda, No. 9, 12-18(1967). (In Russian).

The principles of radioactive dating, some curious contradictions (such as an apparent dependence of absolute age on some sedimentary minerals on grain size), and the pathology of absolute ages (aberrant ages) are discussed. (Geophys. Abstr.)

30695 AGE OF SECONDARY URANIUM MINERALS. Chalov, P. I.; Musin, Ya. A. Byull. Kom. Opred. Absol. Geol. Form., No. 8, 186-9(1967). (In Russian).

Age measurements on secondary minerals of hydrothermal uranium deposits can be made by measuring the accumulation of ionium in samples where the radium : ionium ratio equals one. Ages ranging from 45,000 to more than 400,000 years are reported on uranophane, autunite, tyuyamunite, becquerelite, metatorbernite, schoepite, "mixed P-As micas," and "rejuvenated black" from unnamed deposits. (Geophys. Abstr.)

30696 EFFICIENCY OF WATER DECONTAMINATION FROM RADIOACTIVE SUBSTANCES BY MEANS OF SOIL FILTRATION. Kalandiya, A. A.; Vashakidze, M. A.; Shonvadze, Z. S. Gig. Sanit., No. 3, 48-50(Mar. 1968). (In Russian).

Experimental data are presented on the effect of natural soil filtration on the degree of radioactivity of a river serving as a source of drinking water. The experimental finding was that the natural soil filtration provided absorption of 87.4 to 95.9% of ^{90}Sr. (auth)

30697 INVESTIGATION OF WATER FLOW THROUGH POROUS MEDIUMS BY MEANS OF RADIOTRACERS. Ellis, W. R. (Australian Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales); Kevi, L.; Wiebenga, W. A. Water Resour. Res., 4: 413-16(Apr. 1968).

The radioisotope ^{82}Br was used to measure the flow of water through a packed sand column. It was shown that the commonly accepted Dupuit-Forchheimer assumption did not apply under these conditions. Some information was also given on lateral dispersion using iron gauzes and ^{64}Cu solution. (auth)

30698 ISOTOPE DILUTION ANALYSIS OF RUBIDIUM AND RADIOGENIC STRONTIUM IN GEOLOGIC MATERIALS. Varshavskaya, E. S.; Gorokhov, I. M. Byull. Kom. Opred. Absol. Geol. Form., No. 8, 87-97(1967). (In Russian).

Chemical and mass-spectrometric techniques for the Rb-Sr method of age determination by isotope dilution are reviewed. (46 references). (Geophys. Abstr.)

30699 MEASUREMENT OF THE ISOTOPIC COMPOSITION OF STRONTIUM. Gol'tsman, Yu. V.; Chernyshev, I. V.; Shanin, L. L. Byull. Kom. Opred. Absol. Geol. Form., No. 8, 98-103(1967). (In Russian).

The isotopic composition of strontium and its concentration (by isotope dilution) were measured by a double-beam balancing technique with ^{84}Sr as the tracer, after chromatographic separation of rubidium, using a mass-spectrometer. The technique is sufficiently sensitive to permit dating 0.5 gram samples of rocks 150 to 180 million yr old, containing 1% of rubidium. With a radiogenic strontium concentration around 0.3 ppM, its isotopic composition can be measured with an accuracy of 0.3 to 0.4%. (Geophys. Abstr.)

30700 METHOD OF DIFFERENTIAL DETERMINATION OF THE DENSITY OF ROCKS BY MEANS OF GAMMA-PENETRA-

TION. Varvarina, Ye. K.; Filippov, Ye. M. Geol. Geofiz., Akad. Nauk SSSR, Sib. Otd., 169-83(1966). (In Russian).

A new method of determining density of rocks by means of penetration by a beam of gamma quanta is described. The method is based on the slowing down of gamma radiation as a function of density. The apparatus and procedure are described. The method can be used for differential irradiation of the content of some heavy elements in rocks without destroying the sample. It can differentially determine the density of nonhomogeneous samples. It can determine density on samples up to 10 × 12 cm thick, which means that determinations can be made on rocks full of holes and unconsolidated rocks as well as on solid rocks. Determinations can be made in field or laboratory. Sensitivity is 0.01 to 0.05 g per cm^3 and accuracy 1 to 1.5 percent. (Geophys. Abstr.)

30701 RADIOACTIVITY OF DEPOSITS ALONG THE LUZNICE RIVER. Manova, Magdalena. Vestn. Ustred. Ustavu Geol., 42: 297-9(1967). (In Czech).

Data from an aeroradioactivity survey have revealed an anomaly along the course of the Luznice River in southwestern Czechoslovakia. From studies of 12 samples of river deposits a correlation is established between gamma activity and zircon content. Also, through further analysis by gamma spectrometry, the content of Th and U is found to correspond to the content of these elements in zircon. If the relation, illustrated graphically for the entire area of the anomaly, is representative and extrapolatable, then the average concentration of the zircons in the entire range of deposits is 1 per mille. (Geophys. Abstr.)

30702 RADIOACTIVE ELEMENTS IN GRANITE NEAR STRZEGOM. Mazur, Leopold. Przegl. Geol., 15: 330(1967). (In Polish).

Radioactivity of granite from five locations in the vicinity of Strzegom was determined in the Badania laboratory. Total activity of each and percent of U content and amount of Ra are tabulated. (Geophys. Abstr.)

30703 REMARKS ON THE USE OF NATURAL RADIOELEMENTS IN SEDIMENTOLOGY. Martin, Jean-Marie; Cheminee, Jean-Louis; Olive, Philippe (Faculte des Sciences, Paris). Compt. Rend. Soc. Geol. Fr., No. 6: 246-7(June 19, 1967). (In French).

Since numerous workers have interest in radioelement methods in sedimentology, limitations of the technique are reviewed. Activity occurs to a large degree in heavy minerals; therefore, the tracer chosen is not distributed exactly in the same fashion throughout the whole of the sediment studied. The greatest part of the radioactive elements is found concentrated in the granulometric fraction <100 μ, that is, in the sand, which is not representative of the whole sample; but it is this fraction which undergoes mass transport most significantly. It must be verified whether radioactivity variations are not related to the concentration of a granulometric class dependent on undulations of the sea floor or the topographic profile of the coast. All research attempting to determine sediment origin should be carried out on the same granulometric fraction. Content of Th in samples from Soulac, l'Espiguette, Frejus, and Napoule is analyzed to illustrate the remarks. (BBB)

30704 THERMOLUMINESCENCE OF GEOLOGICAL MATERIALS. Proceedings of a NATO Advanced Research Institute on Application of Thermoluminescence to Geological Problems, Spoleto, Italy, September 1966. McDougall, D. J. (ed.). London, Academic Press, 1968. 694p. 155s. (CONF-660919).

Papers presented are grouped under the following main headings: Introduction; theoretical considerations; techniques; modifying parameters; related phenomena; geological age determination; archeology; radiation dosimetry; climate and paleotemperatures; igneous rocks, wall rock alteration and ore deposits; meteorite and lunar luminescence; miscellaneous applications. Papers of interest in the "nuclear" field include the following: survey of radiation effects applicable to geology problems—P. W. Levy; effects of heating on radiation sensitivity of natural crystals—G. Fornaca-Rinaldi; high sensitivity apparatus to detect thermoluminescence induced by very weak irradiations—J. Labeyrie et al.; use of electron spin resonance for measurement of natural radiation damage—E. J. Zeller; relative efficiency of different radiations in storing thermoluminescent energy—D. Burchell et al.; radiation dosimetry from natural thermoluminescence—N. M. Johnson; evaluation of effective radioactive content by means of thermoluminescent dosimetry—M. J. Aitken; annealing characteristics of lithium fluoride—J. R. Cameron et al.; supralinearity of thermoluminescence of LiF versus dose—D. W. Zimmerman et al.; unexplained radiation phenomena on the moon—J. Hopmann; efficiency of proton excited luminescence of silicate rock powders—D. B. Nash; and thermoluminescence as a method for investigation of radiation chemical effects on frozen compounds—J. Kaufhold et al. (UK)

30705 PRODUCTION RATES OF NEUTRONS IN SOILS DUE TO NATURAL RADIOACTIVITY. Feige, Y.; Oltman, B. G.; Kastner, J. (Argonne National Lab., Ill.). J. Geophys. Res., 73: 3135-42(May 15, 1968).

The relative neutron yield of several targets of light elements exposed to monoenergetic ionized helium beams from the Argonne tandem accelerator was determined for alpha energies ranging from 4.8 to 8.8 MeV. The neutron yields for 5.3 MeV were in agreement with published data on thick target yields obtained with ^{210}Po α particles. The average (α,n) yield per α particle of the natural radioactive series for some elements and for different soil compositions was calculated assuming an (α,n) yield of 75 neutrons per 10^6 α particles of ^{210}Po α for aluminum. If 3 ppM ^{238}U and 11 ppM ^{232}Th are assumed as representative of the earth's upper crust, a production rate of 6.7 ± 0.7 n/g/yr in sand and 13.5 ± 1.3 n/g/yr in granite is obtained. Additional 1.4 n/g/yr will be generated because of the spontaneous fission of ^{238}U. As the production rate of neutrons through interactions of cosmic rays with the earth's surface at sea level is of the order of 800 n/g/yr, these (α,n) reactions cannot be of any significance to exposure rates of human populations. They may be of some interest to geologists, however, and may be the main contributors to neutron fluxes in tunnels, deep caves, or mines, where cosmic-ray background is very low. (auth)

30706 OBRAZOVANIYE EKZOGENNYKH MESTOROZHDENIY URANA I METODY IKH IZUCHENIYA. (Formation of Exogenous Deposits of Uranium and Methods of Investigating Them). Danchev, Vladimir Ivanovich; Strelyanov, Nikolai Pavlovich; Shilovskii, Pavel Petrovich. Moscow, Atomizdat, 1966. 245p.

The natural processes leading to the formation of the main types of exogenic uranium deposits and the most important methods of field, office, and laboratory studies used in solving the problem of the origin and distribution patterns of uranium ores are described. Lithological-geochemical and other methods for investigation of uranium ores and enclosing rocks are described. (ATD)

30707 ^{85}Kr MEASUREMENT OF STREAM REAERATION RATES. Tsivoglou, E. C. (Georgia Inst. of Tech., Atlanta). Trans. Amer. Nucl. Soc., 11: 51-2(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30708 MONITORING OF RADIOISOTOPES IN ENVIRONMENTAL WATER. Riel, Gordon K.; Duffey, Dick. Trans. Amer. Nucl. Soc., 11: 52-3(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30709 PROBLEM OF NUCLEAR GEOPHYSICAL METHODS OF DETERMINING THE COMPOSITION OF ROCKS AND ORES. Filippov, Ye. M. Geol. Geofiz., Akad. Nauk SSSR, Sib. Otd., 5-122(1966). (In Russian).

All present radioactivity methods of determining the composition of rocks and ores are examined and classified according to the principle on which they are based (natural radioactivity, ampule sources) and used (logging, surveying, profiling, assaying). Their possibilities for studying the elementary composition of rocks and ores are discussed. The characteristics of the various methods are summarized in a table under the headings nuclear reaction or other physical phenomenon used, particle recorded, field of application, and abbreviation. Another table shows the possibilities of using the methods to determine the chemical elements, with an indication of the accuracy attainable. A third table gives the nuclear geophysical constants of the isotopes of all the elements from hydrogen to plutonium. (Geophys. Abstr.) (auth)

30710 RADIATION TREATMENT OF ACID MINE DRAINAGE. Steinberg, M.; Pruzansky, J.; Jefferson, L. R.; Manowitz, B. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc., 11: 56(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30711 RADIATION TREATMENT OF WASTE WATERS. Etzel, James E.; Condren, Arthur J. (Purdue Univ., Lafayette, Ind.). Trans. Amer. Nucl. Soc., 11: 56-7(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30712 TAKING INTO ACCOUNT THE EFFECT OF WELL CONDITIONS ON THE RESULTS OF INVESTIGATIONS OF THE NATURAL RADIOACTIVITY OF SEDIMENTARY ROCKS. Larionov, V. V. Tr., Mosk. Inst. Neftekhim. Gazov. Prom., No. 67, 104-14(1967). (In Russian).

For interpretation of gamma logs obtained in oil and gas wells it is necessary to have information on the radioactivity of the rocks penetrated by the well and of the drilling solution at the time of the measurements. An approximation of the radioactivity of a given formation can be obtained directly from the value of gamma ray intensity recorded opposite it; the radioactivity of the drilling fluid can be obtained only by measuring it directly. Master curves are given for calculating the effect of variations in diameter of an uncased well on the intensity of gamma radiation, measured by instruments in the center of or along the wall of the well. These master curves are valid only for curves measured by apparatus using gas discharge counters, not scintillation counters. (Geophys. Abstr.)

30713 HYDROLOGICAL APPLICATIONS OF RADIOISOTOPES IN AUSTRALIA. Ellis, W. R.; Miles, G. L. (Australian Atomic Energy Commission, Lucas Heights). Isotop. Radiat. Technol., 5: 342-5(Summer 1968).

Australian research and development work on the application of radioisotopes to hydrological studies is summarized. Such studies include ground water flow, dispersion and mixing, and sediment movement in rivers, harbors, and oceans. Safety aspects of the use of radioisotopes are also discussed. It was concluded that apart from the development that may result from further research, it is already possible to use radioisotopes in the solution of a wide variety of hydrological problems. (R.C.K.)

30714 VARIATION OF ^{18}O/^{16}O IN MINERALS AND ROCKS. Epstein, Samuel; Taylor, Hugh P. Jr. pp 29-62 of Researches in Geochemistry, Vol. 2. Abelson, Philip H. (ed.). New York, John Wiley and Sons, 1967.

The oxygen isotope compositions of rocks and minerals are dependent on their genesis and history. The ^{18}O : ^{16}O ratio of each igneous mineral is generally constant, so that the ratio of a rock reflects the proportion of the minerals composing it. Deviations from this usually reflect a specific process such as fractional crystallization. The ^{18}O : ^{16}O ratio of metamorphic rocks and minerals may reflect the grade of metamorphism, and may be used as a geothermometer. Oxygen isotope data on sedimentary silicate rocks are few, and further study should help answer questions as to genesis. The Δ values of different mineral pairs give good indications of the temperatures of final equilibrium for a variety of rock types, and further calibrations and measurements should establish the isotope method of measuring temperatures. (auth) (Geophys. Abstr., No. 257, June 1968)

Meteorology

Refer also to abstract 30825.

30715 (SWRHL-30r) FINAL REPORT OF OFF-SITE SURVEILLANCE FOR THE NRX-A4/EST TEST SERIES. (Public Health Service, Las Vegas, Nev. Southwestern Radiological Health Lab.). Sept. 19, 1966. 43p. Dep. CFSTI.

The off-site radiation surveillance for the NRX-A4/EST Project Rover Reactor test series which took place at NRDS test cell A is described. Of the six experimental plans in the test series, four resulted in detectable quantities of radioactivity in off-site areas. Although radioactive effluent was detected off-site from this event, the surveillance indicated that the radiation protection guides established by the Atomic Energy Commission (based on Federal Radiation Council guidelines), Chapter 0524, for the off-site population were not exceeded. The peak off-site potential thyroid exposure was about 36 millirad at Lone Pine, California. (auth)

30716 RADIOCERIUM CONCENTRATIONS IN GROUND-LEVEL AIR AFTER THE NUCLEAR EXPLOSION OF MAY 9, 1966. Thein, M.; Johnson, H.; Kuroda, P. K. (Univ. of Arkansas, Fayetteville). J. Geophys. Res., 73: 3129-34(May 15, 1968).

Variations of the ^{141}Ce and ^{144}Ce activities in the ground-level air were measured at Fayetteville (94°W, 36°N), Arkansas, for a period of about 3 months after the Chinese nuclear explosion of May 9, 1966. A cyclic pattern of variations was observed for both ^{141}Ce and single fallout particles. This cyclic pattern indicated that they were airborne for a long period and traveled far. Some of the particles may have circled the earth many times. (auth)

30717 EFFECTS OF GROUND ROUGHNESS ON FALLOUT PROTECTION FACTORS. French, R. L.; Price, J. H. (Radiation Research Associates, Inc., Fort Worth, Tex.). Trans. Amer. Nucl. Soc., 11: 421(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30718 ATTENUATION OF FALLOUT GAMMA RADIATION BY A BASEMENT CEILING. Kaplan, Arthur L. (Technical Operations, Inc., Burlington, Mass.). Trans. Amer. Nucl. Soc., 11: 421-2(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30719 NEW LOOK AT GAS EFFLUENT DILUTION FACTORS. Barry, Peter J. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Trans. Amer. Nucl. Soc., 11: 6(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30720 A REVIEW ON THE DETERMINATION OF MASS RETURN FLOW OF AIR AND WATER VAPOUR INTO THE STRATOSPHERE USING TRITIUM AS A TRACER. Smith, R. Michael (International Meteorological Inst., Stockholm). Tellus, 20: No. 1, 76-81(1968).

A review is presented of recent work on the uses of tritium in tracing general atmospheric motions. Using monthly moisture flux data it was possible to determine the regions of major outflow of air and water vapour through the tropopause into the stratosphere over North America for July 1962. It was found that these areas were closely related to the mean position of the jet stream. Computations were made of the total masses of air and water vapour leaving the troposphere. It is postulated that the energy involved in the outflow of air from the troposphere in the vicinity of the mid latitude jet stream and originating entirely from the large scale transient eddies is transferred directly into the lower stratosphere. This transfer of kinetic energy through the tropopause is considered to be the principal mechanism for the maintenance of the dynamic circulation of the lower stratosphere. It is tentatively suggested that such outflow of tropospheric air, at least in mid latitudes, initiates extrusions of stratospheric air as a compensatory mechanism in an effort to restore equilibrium in an otherwise dynamically inactive stratosphere. (auth) (Sweden)

30721 A STUDY OF THE CONCENTRATION OF LONG-LIFE RADIOACTIVE AEROSOLS IN THE ATMOSPHERE IN RELATION TO ITS DUST CONTENT. Kozlova, M. V.; Korenkov, I. P.; Novikov, Yu. V.; Granovskaya, D. D. (Moscow City Sanitation Station, Moscow Scientific Research Inst. of Sanitation). Gig. Sanit., No. 3, 42-5(Mar. 1968). (In Russian).

Data are presented on the existing interrelation between the concentration of long-life radioactive aerosols and the amount of dust in the atmosphere. The coefficient of correlation was equal to +0.4 ± 0.08. This proves such interrelation to be of a proportional nature. (auth)

30722 DETERMINATION OF THE DEGREE OF EQUILIBRIUM BETWEEN ^{222}Rn AND ITS DAUGHTERS IN THE ATMOSPHERE BY MEANS OF ALPHA-PULSE SPECTROSCOPY. Lindeken, C. L. (Univ. of California, Livermore). J. Geophys. Res., 73: 2823-7(Apr. 15, 1968).

Diurnal variations in the concentration of airborne radon daughters were studied by means of an alpha-pulse spectroscopy method. The effect of these variations on the background of whole-body counters, arising from the gammas accompanying RaB (^{214}Pb) and RaC (^{214}Bi) was determined. The advantages and disadvantages of alpha-pulse spectroscopy are summarized. It was found that there is little correlation between the degree of secular equilibrium and the radon daughter concentration, particularly for samples collected during the morning. (R.C.K.)

30723 DISTRIBUTION OF ARTIFICIAL RADIOACTIVITY IN THE LOWEST 300 METER LAYER OF THE ATMOSPHERE. Meszaros, Erno; Simon, Antal. Idojaras, 71: 173-4(May-June 1967). (In Hungarian).

Results of observations indicated that, in the lowest 300 m of the atmosphere, the vertical gradient of artificial β-radioactivity may be equal to zero. (Meteorol. Geoastrophys. Abstr.)

30724 DEPOSITION OF RADIOACTIVE FALLOUT IN NIIGATA CITY. REPORT 1. RADIOACTIVE RAIN, SNOW, AND ATMOSPHERIC DUST OBSERVED IN 1960 TO 1962. Kosaka, Takao; Sugai, Ryuichi (Niigata Univ., Japan). Niigata Igakkai Zasshi, 81: 589-93(Nov. 1967). (In Japanese).

The changes in radioactive fallout, including rain, snow, and atmospheric dust, were investigated in Niigata City from 1960 to 1962. The total annual amount of radioactive rain and snow and of radioactive atmospheric dust was the lowest in 1960, due to the suspension of nuclear tests in November 1958. Both increased drastically in 1961 and 1962 because of test resumption. The falling of highly radioactive particles was observed in October 1961, due to the major Soviet test. The ratio in radiation intensity of rain (and snow) and atmospheric dust was 11 : 1, nearly similar to the 13 : 1 up to 1959. The falling of radioactive rain (and snow) and of atmospheric radioactive dust, as in the previous years, tended to be small in spring and summer and large in autumn and winter. This again showed clearly a seasonal variation in radioactive fallout in the region. (auth)

30725 EFFECTS OF WINDS ON ATMOSPHERIC PRESSURE WAVES PRODUCED BY HYDROGEN BOMBS. Mackinnon R. F. (Imperial Coll. of Science and Tech., London). J. Meteorol. Soc. Japan, 46: 45-59(Feb. 1968).

Numerical evaluations of theoretical expressions for ground pressure waves due to explosions in the atmosphere are presented for a model atmosphere containing winds. Various wind conditions are studied and distinction is made between winds of the upper and lower atmosphere. It is found that wave speed and amplitude depend on wind conditions, so that any analysis of microbarograms must take into account prevailing wind conditions. Previously published records were studied in the light of the new results presented. (NSA of Japan)

30726 RADON CONCENTRATION OF THE GROUND LAYER OF THE ATMOSPHERE IN RELATION TO METEOROLOGICAL FACTORS. Chkhenkeli, Sh. M.; Donadze, Sh. K.; Khundzhua, T. G.; Golub, T. V. Soobshch. Akad. Nauk Gruz. SSR, 48: 555-60 (Dec. 1967). (In Russian).

A correlation of observational data for the intrinsic radioactivity of the ground layer of the atmosphere with the behavior of meteorological elements for the period from 1959 to 1965 is given. A dependence is found between the concentration of the radon decay products and certain meteorological factors. Mean monthly values of radon concentration are compared with wind erosion. The radioactivity in the air is found to be higher in the WNW direction and lower in the ESE direction. This is attributed to the wind erosion of different geological structures. A histogram of atmospheric radioactivity is constructed, and mean monthly values are calculated for the coefficient of turbulent mixing in 1961 and 1965. (IAA)

30727 RELATION BETWEEN ^{144}Ce AND ^{90}Sr RAINOUT IN CONVECTIVE RAINSTORMS. Huff, F. A.; Stout, G. E. (Illinois State Water Survey, Urbana). Tellus, 20: No. 1, 82-7(1968).

Analyses were made of the time and space distribution of the concentrations of ^{144}Ce and ^{90}Sr in 1963 convective storms in Illinois through use of a network of 16 automatic rainwater samplers operated in conjunction with recording rain gages and weather radar sets. Great space and time variability were found in the ^{144}Ce/^{90}Sr ratio in these storms. A relatively strong trend was found for the above ratio to decrease during the life of storms. A relatively weak trend was noted for the average ratio of ^{144}Ce/^{90}Sr to decrease with increasing amounts of total storm rainfall. Implications of these findings are discussed. (auth) (Sweden)

Mineralogy and Exploration

Refer also to abstracts 30498 and 30695.

30728 (JEN-167-SIG/1-5) DESEQUILIBRIO RADIACTIVO. I. METODO β-γ. "DETERMINACION DE LA RAZON eRa/U. VALORACION DEL CONTENIDO EN U_3O_8. (Radioactive Disequilibrium. I. β-γ Method. Determination of the Equilibrium Ra/U Ratio. Appraisal of the Content in U_3O_8). Mingarro, E. (Junta de Energia Nuclear, Madrid (Spain)). 1966. 124p. (In Spanish).

The main problems concerning the radioactive nonequilibrium of minerals, and a simultaneous counting procedure for β and γ activities developed to solve those problems, are described. (auth)

30729 URANIUM AND THORIUM IN THE VOLCANIC PROCESSES. Locardi, E. (Comitato Nazionale per l'Energia Nucleare, Rome). Bull. Volcanol., 31: 235-60(1967). (RT/GEO (67)7).

Distribution of radioactive elements in the Quaternary alkaline volcanites of Northern Latium was studied and conclusions of volcanological interest, both as to differentiation of magma in the more superficial levels of the crust and as to the relationship between volcanic eruption and concentration of particular elements, were drawn. The following principal results are emphasized: there are two well defined types of distribution of U and Th corresponding to fractional crystallization differentiation and to pneumatolytic (gaseous transfer) differentiation; the distribution of U and Th characterizes better than different situations mentioned above than major elements do. In effect, in the magnatic conditions examined, the differentiation processes do not affect magma inside the magma chamber only, but often may push on up to the surface through fumarolic activity; the close interdependence among gas concentration, increase in trace pneumatophyles and volcanic eruption allows basic information to be extrapolated from concentration and distribution of U and Th to the primary causes of volcanic activity and to the gaseous phase increase and exsolution; and original magma type being equal, the shape of the magma chamber influences strongly on the kind of differentiation and on the type of volcanic eruption. (auth)

30730 THORIUM. Baroch, Charles T. Eng. Mining J., 169: 117-19(Mar. 1968).

Domestic production, consumption, and uses of Th and Th-alloys in 1967 are reviewed. Other topics include production of monazite and uranothorianite in Malaysia, South Africa, South America, Canada, and Australia. Developments in use of Th for nuclear fuels in the U.S. are discussed. (P.G.C.)

30731 URANIUM. Sherman, John T. Eng. Mining J., 169: 106-10(Mar. 1968).

The growth of exploration for U in the U.S. and other countries in 1967, production, U.S. reserves, government actions, sales of U_3O_8, and price ranges are reviewed. Forecasts for the growth of nuclear power installations in the U.S. to 1975 are discussed. (P.G.C.)

30732 THORIUM RESOURCES IN ITALY. Mittempergher, Mario (CNEN-CSN della Casaccia, Rome). Com. Naz. Energ. Nucl., Notiz., 14: No. 3, 33-42(1968). (In Italian).

After fifteen years of prospecting for radioactive ores in Italy, it is now possible to make an evaluation of Italy's thorium reserves and resources. This evaluation, suitably fitted into the geologic and genetic context of the essential orebodies with a view to determining its character and economic limitations, takes into account the breakdown of costs per pound of ThO_2 according to the present practice. (auth)

30733 URANIUM EXPLORATION IN SWITZERLAND. Com. Naz. Energ. Nucl., Notiz., 14: No. 3, 63-5(1968). (In Italian).

A review of the estimated uranium reserves in the Swiss Confederation is presented. (auth)

30734 PROBLEM OF RADIOACTIVE EQUILIBRIUM IN URANIFEROUS MINERALS. Richard, Pierre; Jurain, Georges; Coppens, Rene (Centre de Recherches Radiogeologiques, Nancy). Compt. Rend., Ser. D, 266: 654-6(Feb. 12, 1968). (In French).

Gamma spectrometry on natural minerals with respect to the initial equilibrium states makes it possible, in a single operation, to determine the radioactive equilibrium state of the uraniferous minerals. (tr-auth)

30735 STATISTICAL EVALUATION OF URANIUM RESOURCES. Meehan, R. J.; Grundy, W. D. (Atomic Energy Commission, Grand Junction, Colo.). Trans. Amer. Nucl. Soc., 11: 121(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

Oceanography

Refer to abstract 30736.

Seismology

Refer to abstracts 33192 and 33193.

ENGINEERING

Nuclear Explosions

Refer also to abstracts 30725, 30749, 32616, 32619, and 33199.

30736 (NVO-99-24) SEICHE AND TSUNAMI EFFECTS FROM NUCLEAR EXCAVATION OF AN INTEROCEANIC CANAL. (Blume (John A.) and Associates Research Div., San Francisco, Calif.). Feb. 1968. Contract AT(26-1)-99. 49p. Dep. CFSTI.
Includes Appendix by R. L. Wiegel.

Potential damage from water waves, including seiches and tsunamis which might be generated by proposed nuclear excavation in the Isthmus of Panama, is investigated. The history of the region shows a relative freedom from earthquake-generated waves. Predicted ground motion for the Panama Canal area will probably cause only negligible wave heights in the Canal. Nuclear excavation intersecting the shoreline may generate waves of damaging proportions. Additional studies are recommended. (auth)

30737 (VUF-1036) OFF-SITE SURVEILLANCE FOR PROJECT STERLING. Carter, Melvin W.; Placak, O. R. (Southeastern Radiological Health Lab., Montgomery, Ala. Public Health Service, Las Vegas, Nev. Southwestern Radiological Health Lab.). Dec. 3, 1966. 46p. Dep. CFSTI.

The program conducted to assure the safety of residence in the area near the underground test explosion, Sterling Event, is described in detail. Preparations included a census of inhabitants and animals in the area, evacuation of residents within a 2 mile radius of the test site, and radiation monitoring and environmental sampling following the detonation. The data gathered indicated that no detectable radioactivity was released to the off-site area as a result of Sterling. (L.C.L.)

30738 EL PASO NATURAL GAS COMPANY'S PARTICIPATION IN PROJECT GASBUGGY. Gevertz, Harry (El Paso Natural Gas Co., Tex.). Trans. Amer. Nucl. Soc., 11: 177(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30739 NUCLEAR EXPLOSIVE: ITS POTENTIAL FOR INDUSTRY. Werth, Glenn C. (Univ. of California, Livermore). Trans. Amer. Nucl. Soc., 11: 177(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30740 GASBUGGY PRELIMINARY POSTSHOT SUMMARY REPORT. Holzer, Fred (Univ. of California, Livermore). Trans. Amer. Nucl. Soc., 11: 177-8(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30741 DISC TO DETERMINE DETONATION FORCE. Klose, K. Militartechnik, No. 12, 562(1967). (In German).

A rapid visual method, intended for military field use, involving the use of a computational disc has been proposed for determining the detonation force of a surface or atmospheric nuclear burst. Unlike previous methods which relied primarily on the light period of the fire ball, the new method is based on the parameters of the detonation cloud and the time interval between original sighting and the arrival of the pressure wave. Sample problems to illustrate the new method are given. (JPRS)

30742 INDUSTRIAL APPLICATIONS OF NUCLEAR EXPLOSIVES PLANNED IN THE U. S. Com. Naz. Energ. Nucl., Notiz., 14: No. 3, 68-73(1968). (In Italian).

Two new projects have been recently developed in the U. S. within the framework of Program Plowshare: Project Bronco and Project Sloop. Project Bronco envisages the use of underground nuclear explosions for the recovery of petroleum from oil shales; Project Sloop is concerned with the possible use of nuclear blasts for the recovery of copper from low-grade orebodies. (auth)

30743 NUCLEAR WEAPON RESEARCH AND ITS SEQUELA. Langhans, K. Militartechnik, No. 9, 402-5(1967). (In German).

Nuclear weapon research, specifically nuclear bomb tests, and the deleterious effects of heightened radioactivity levels on the world's biology, are discussed. The basic difference between techniques of nuclear weapon research of the U. S. A., England, France, and China, as opposed to those of the Soviet Union is discussed. The effects of the U. S. A. bombing of Hiroshima and Nagasaki, as well as the U. S. A. bomb test of March 1, 1964, are listed as examples of the types of damage to be expected. "Clean" nuclear tests and the use of three-phase nuclear weapons with concomitant decreased levels of radioactivity produced are listed as alternatives, based on Soviet experience. Major topics include: the influence of the number and type of nuclear weapon tested; the influence of restrictions on detonations; the possible influence of nuclear weapon detonation on weather; the activity-concentration in marine organisms and the effects on their biological cycles; and nuclear tests at great heights. It is concluded that obvious deleterious effects of such testing should be minimized. (JPRS)

30744 PEACEFUL USES OF NUCLEAR EXPLOSIVES. Pohland, Erich. At. Strom, 14: 1-8(Jan. 1968). (In German).

The application of nuclear explosions to peaceful purposes is discussed. The general principles are explained. A report is given on the "Plowshare Symposia" held in the U. S. A. and on underground blasting operations which have been carried out on the Nevada test site. The economics of blasting operations are discussed, as well as radiological safety and the calculations required for blasting. Finally a description is given of a few projects for roads and canals, artificial harbors, as well as loosening of earth layers. (tr-auth)

30745 IN SITU RETORTING OF OIL SHALE USING NUCLEAR ENERGY. Jacobs, Robert B.; Wright, Lawrence T. (to Standard Oil Co.). U. S. Patent 3,342,257. Sept. 19, 1967. Filed Dec. 30, 1963.

A method for recovering oil from a subsurface oil shale formation with a nuclear device comprises drilling an excess well into the formation, inserting a nuclear explosive device in the well near the bottom of the formation, sealing the well above the formation to confine the nuclear explosion, and detonating the device to create a cavity in the formation which at least partially fills with collapsing shale to form a zone of fractured and crumbled shale of high permeability. At least one gas input conduit and one recovery conduit are connected to the reflux zone, and hot retorting gas is flowed through the gas input conduit into a part of the fractured shale to heat the shale and distill the oil from it. (B.L.M.)

Facilities and Equipment

Refer also to abstracts 30796, 30810, 31734, and 33195.

30746 (K-L-2532(Rev.)(Add.1)) K-II CENTRIFUGE INSTRUCTION MANUAL. Denny, E. C.; Gibson, R. F.; Nunley, C. E. (Oak Ridge Gaseous Diffusion Plant, Tenn.). Feb. 23, 1968. Contracr W-7405-eng-26. 37p. Dep. CFSTI.

The K-II zonal ultracentrifuge system is a high-capacity, continuous-flow centrifuge suitable for commercial applications such as large-scale purification of drugs and vaccines or research applications in biological laboratories. Since the machine was designed for production-type separation work, simplicity of operation and ease of maintenance were prime considerations. A top mounted air turbine unit supports and drives the centrifuge rotor directly while the lower rotor shaft is supported radially by the lower damper bearing. The rotor chamber is held under high vacuum to minimize drag and heating at high speeds. Both rotor shafts are hollow and single path rotating seals are used on both ends of the rotating system. Rotor acceleration, operating speed, and other machine functions are controlled by an electronic-pneumatic control system. The recommended operational procedure is continuous flow with banding using the reorienting gradient technique of static loading and unloading. Complete instructions for operating, maintaining, and trouble shooting the centrifuge are given. (auth)

30747 (NAA-SR-Memo-12404) CRYOSTATS FOR LOW TEMPERATURE ELECTRON IRRADIATION AND ANNEALING STUDIES FROM 4.2 TO 900°K. Neely, H. H. (Atomics International, Canoga Park, Calif.). May 1, 1967. Contract AT(04-3)-701. 28p. Dep. CFSTI.

Innovations in low temperature irradiations are discussed. Four cryostats for low-temperature electron irradiation of metals and semiconductors incorporating various diagnostic tools of investigation are described in some detail. Subsequent annealing of the samples in situ is an important consideration given these cryostats, the sample pulsing temperature range to as high as 900°K. There are basically two different heat switch configurations in the cryostats. Sample mounting techniques, temperature control, thermal heat sinks of sapphire, and variations of Faraday cages are reviewed. (auth)

30748 (RFP-1096) AIR GAGE FIXTURE FOR MEASUREMENT OF WORK-PIECE SEATING LOCATION. Larson, R. A. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). May 9, 1968. Contract AT(29-1)-1106. 3p. Dep. CFSTI.

An open air-jet mounted in a work-holding fixture to measure the work-piece seating location prior to machining is described. Machine-tool compensations can then be made to eliminate final-product error due to inconsistent seating of parts. (auth)

30749 (UCID-15307) PROMPT SAMPLE RECOVERY SYSTEM FOR NUCLEAR EFFECTS EXPOSURES. Rienecker, F. (California Univ., Livermore. Lawrence Radiation Lab.). Apr. 1968. Contract W-7405-eng-48. 11p. Dep. CFSTI.

A cable tramway system was designed for prompt recovery of samples exposed to prompt radiation from nuclear explosions. An 80-lb sample was removed from the tower and transported about 230 ft within 9 sec after detonation. (auth)

30750 A CONTAINER FOR THE TRANSPORT AND TRANSFER OF RADIOACTIVE FLUID. Andre, Roger; Fradin, Jean; Gaudichard, Claude (to Commissariat a l'Energie Atomique). British Patent 1,114,919. May 22, 1968. Priority date Feb. 23, 1966, France.

A container for the transport and transfer of radioactive liquids is described. The container is comprised of a biological shield having a recess for a bottle with a perforable closure seal, a removable shielding plug permitting the bottle to be inserted in and removed from the recess, a movable plate supporting two hollow needles fixed to the plate at one end, a guide sleeve with a handle pivoted on the outside the sleeve, and a method of locking the sleeve to keep in the transport position both the sleeve and the shield. The container is designed to minimize radiation and contamination risks. (R.C.K.)

30751 AN AIRBORNE GAMMA-RAY SPECTROMETRY SYSTEM FOR GEOLOGICAL SURVEYING. Bristow, Q.; Donhoffer, D. K. (Atomic Energy of Canada Ltd., Ottawa). Trans. Amer. Nucl. Soc., 11: 66(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30752 MONTE CARLO PROGRAMMING FOR SMALL COMPUTERS. Price, J. H. (Radiation Research Associates, Inc., Fort Worth, Tex.). Trans. Amer. Nucl. Soc., 11: 420-1(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30753 ULTRA-FINE ADJUSTMENT FOR OBJECTIVE WITH SUPERCONDUCTING WINDING. Bonhomme, Pierre; Cheret, Christian; Laberrigue, Andre; Levinson, Paul (CNRS, Paris. College de France, Paris. Faculte des Sciences, Reims, France). Compt. Rend., Ser. A and B, 266: 289-91(Mar. 4, 1968). (In French).

It is shown that it is easy to create very small current variations in the superconducting exciter circuit of a magnetic lens used as the objective in an electron microscope. A focal series is given. (tr-auth)

30754 TECHNOLOGY OF NUCLEAR FUELS: STATE IN GERMANY. Braatz, Ulrich. VDI (Ver. Deut. Ing.) Z., 110: 147-8(Feb. 1968). (In German).

A bibliographic review summarizes the technological facilities available in Germany for the production and processing of nuclear fuels. The fuel elements for the various types of reactors in operation in Germany are briefly described. 21 references. (J.S.R.)

30755 NEW TRANSMITTED LIGHT HOT STAGE. Hott, A. C.; Eichelberger, R. L. (Atomics International, Canoga Park, Calif.). pp 233-43 of Sintering and Related Phenomena. Proceedings of the International Conference, Univ. of Notre Dame. Kuczynski, G. C.; Hooton, N. A.; Gibbon, C. F. (eds.). New York, Gordon and Breach, Science Publishers, 1967.

See CONF-650644.

A new hot stage for use with a petrographic microscope has enabled time lapse motion pictures to be made, which showed a number of phenomena occurring in BeO sections during heating at about 1700°C. Among the phenomena observed are grain boundary movement, pore migration, and thermal etching of the surface. Crystal faces may be identified, and crystallographic orientation was shown to exert a very strong effect on the nature of grain boundary movement. The film record was used to derive grain-growth kinetic data. Isothermal grain growth in thin (viz., two-dimensional) BeO specimens appeared to follow the expression, $D^2 - D^2 = K(t - t_0)^{1/4}$. (auth)

30756 DIRECT METHOD FOR MEASURING RELEASED ENERGY. Kemeny, G.; Rother, H.; Von Birgelen, G. (CCR-EURATOM, Petten, Netherlands). pp 3-8 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

Calorimetric equipment and techniques for measuring stored energy release in ceramic materials, such as graphite and Al_2O_3, are described. A schematic diagram of the calorimeter, thermocouples, recorders, and controls is shown, as are measurement equations. (P.G.C.)

30757 GAMMA IRRADIATION FACILITY WITH COMPLEX SOURCE. P'yankov, G. N.; Brashkin, M. A. At. Energ. (USSR), 24: 192-3(Feb. 1968). (In Russian).

The irradiator consists of a cylindrical and conical section. The cylindrical part with an inner diameter of 152 mm is formed of 16 stainless steel tubes with a diameter of 14 × 12 mm, spaced equally on the perimeter of the cylinder. The height of this part of the irradiator is 95 mm. The conical part consists of four tubes 250 mm long and 12 tubes shortened by $1/3$. Each part of the irradiator contains ^{60}Co in 44 units of activity with 400 to 1200 g-equiv. radium in each unit. The unit is intended to irradiate conical articles at the bottom of a pool of water which serves as the radiation shield. The irradiated article is rotated to average out the dose. The average irradiation dose is 470 Rad/sec. (TTT)

30758 OREGON STATE UNIVERSITY RADIATION CENTER. Baker, P. S. Isotop. Radiat. Technol., 5: 299-30(Summer 1968).

The Radiation Center of Oregon State University, Corvallis, a facility designed to accommodate instruction and research programs in nuclear science, is described and illustrated. The major facilities, i.e., the different radiation sources, and the specialized laboratories are included. (B.S.L.)

30759 SACLAY FACILITY FOR PREPARATION OF RADIOISOTOPE-LABELED MATERIALS. Gerrard, Martha. Isotop. Radiat. Technol., 5: 340-1(Summer 1968).

The facility at the Centre d'Études Nucléaires at Saclay for the preparation of radioisotope-labeled materials is described. The building, including the ventilation system and building services, is described. The equipment used in the facility is briefly discussed. (R.C.K.)

30760 THE PILOT-PLANT MEAT IRRADIATOR: KEYNOTE TO COMMERCIAL FOOD IRRADIATION. Dietz, George R. (Atomic Energy Commission, Washington, D. C); Wootten, Carl B.; Silberstein, Morton S.; Masefield, John. Isotop. Radiat. Technol., 5: 292-8(Summer 1968).

Construction of the world's first irradiation facility for the sterilization of meat products is scheduled to begin shortly. This project will begin the minute the U. S. Department of Agriculture and Food and Drug Administration give their approvals to radiation-processed ham, based on petitions submitted by the Department of the Army in August 1966. When completed, the 400-kilocurie ^{60}Co facility will be capable of processing up to 3 million lb of sterilized product per year. Ham will constitute the major meat item for initial processing. The Department of Defense has agreed to purchase 300 thousand lb of meat and poultry per year, for each of the first 3 years of operation. Another portion will be introduced into the civilian market. Excess plant capacity will be used to process an irradiated pet food to be introduced on the market. This article recounts the total project from its inception to its present status. (auth)

30761 PLANETARY SWAGER (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1723).

6 drawings.

A planetary ball swager is described which utilizes force exerted by hardened-steel balls rolling in a conical outer race on the tubing which acts as an inner race. The outer race is rotated by an external power source. The tubing which is held to prevent rotation is drawn through the opening inside the track of the rotating balls. Reduction is controlled by the inside diameter of the outer race and the size and number of the hardened-steel balls. With the swager, the finished diameter can be readily changed by repositioning the balls within the tapered outer ring. Thus, different dies are not required for products of different diameters. (For details see TID-4100.) (F.S.)

30762 ROTATING SAMPLE HOLDER (Engineering Materials). (General Electric Co., St. Petersburg, Fla. Pinellas Peninsula Plant). (CAPE-1735).

2 drawings.

A rotating sample holder used in x-ray emission analysis of non-homogeneous samples is described. Rotation provides more reliable x-ray emission data by averaging non-homogeneous irregularities from different sample areas which are observed continuously. The sample holder is used on a GE XRD-6 x-ray emission spectrometer. X ray intensity variations obtained by using the sample holder for continuous sample rotation shows significant improvement in overall precision when compared to intensity variation by rotation only between readings. (For details see TID-4100.) (F.S.)

30763 CONTROL APPARATUS FOR HANDLING DEVICE. (to Commissariat a l'Energie Atomique). French Patent 1,336,291. July 22, 1963. Filed July 18, 1962.

A control apparatus for a handling device has a system for the attachment and detachment of the load. The system is provided with a safety program and is driven by a cable which is operated by a winch. The apparatus comprises, between the winch and the handling device, a system of control of a succession of raising and lowering of the cable according to the cycle of the program. Means are provided for the control of the stopping of the winch, and the initiation of the program, the end of the program causing the starting of the winch. The stopping of the program in a specific zero position causes the restarting of the winch. (IIB)

30764 IMPROVEMENTS IN FILTERS FOR HAZARDOUS GASES. Auckland, John Raymond (to Vokes Ltd.). British Patent 1,109,365. Apr. 10, 1968. Filed Apr. 27, 1964.

Means for removing a contaminated filter and fitting a fresh filter in a filter system for hazardous gases such as radioactive dust are described. The apparatus consists of a plastic bag fitted with projections or gloves which permit manipulation of the filters. (W.H.K.)

30765 METHOD AND TOOL FOR EXTRACTING AND INSERTING HEAT EXCHANGER TUBES. Belanger, Celestin Victor (to Henry W. Allen). U. S. Patent 3,341,930. Sept. 19, 1967. Filed Mar. 24, 1964.

A device is described that provides for the simultaneous extraction of an old heat exchanger tube from its position within the openings in spaced tube sheets and replacement with a new tube. The machine includes a mandrel device consisting of a pair of interchangeable mandrel rods of somewhat greater length than that of one of the tubes and of an outside diameter but slightly smaller than the inside diameter of the tubes. One of the rods is adapted to be inserted within the old tube with one end protruding in the direction of the withdrawal of the tube and with the other end at the opposite end of the tube provided with a longitudinally extending beveled surface. The other rod is adapted to be inserted within the new tube in a similar manner. The beveled surface of the second rod is provided with a longitudinally beveled surface complementary to the beveled surface of the first rod and interfitted with it when the old and new tubes are brought into end-abutting relationship. This wedging interfit of the beveled ends of the rods serves to effect internal gripping of the tubes for longitudinal forced movement of the tubes and at the same time to buttress the walls of both tubes to prevent distortion of the tube walls. The protruding end of the second row is provided with a shoulder depressed within its periphery that is adapted to be impacted in the opposite direction to the movement of the tubes in order to break the wedging interlock of the beveled rod ends when the new tube is ultimately in place. (B.L.M.)

30766 WORKING CHAMBER OR GLOVEBOX. Gandolfo, Jean-Marie; Rouillard, Jean (to EURATOM). British Patent 1,111,621. May, 1, 1968. Priority date Feb. 3, 1965, France.

A hermetically sealed glovebox which may be used inside hot cells for handling radioactive materials is described. A flexible sleeve surrounds the manipulator and seals the opening. (W.H.K.)

Heat Transfer and Fluid Flow

Refer also to abstracts 30765, 32768, 33146, 33153, 33164, 33165, 33175—33178, and 33181.

30767 (AERE-R-5693) LIQUID PHASE MASS TRANSFER IN ANNULAR TWO-PHASE FLOW: RADIAL LIQUID MIXING. Cousins, L. B.; Hewitt, G. F. (Atomic Energy Research Establishment, Harwell (England)). Feb. 1968. 46p. Dep. CFSTI. UK.

An experimental study of mixing and liquid interchange in annular two-phase flow is described. Annular flow with liquid entrainment was set up in a long vertical tube and at a point far from the injector, where the flow characteristics were no longer changing rapidly with length, a dyestuff was injected around the periphery of the tube into the liquid film. In a first series of experiments, the change with length of the dyestuff concentration in the liquid film was determined. These experiments confirmed previous findings with a different system, viz the dyestuff is inhomogeneously mixed within the liquid film itself for long distances along the channel. The fact rendered inaccurate the use of this technique in determining the rate of liquid interchange between the liquid film and the droplet-laden gas core; however, an approximate measurement of the interchange rate can be obtained if mean film concentrations are used. In a further series of experiments, an isokinetic probe was used to determine the radial distribution of liquid mass flowrate, gas mass flowrate and dye concentration at various axial positions upstream of the point of dye injection; ultimately, the dyestuff became homogeneously mixed in the liquid phase. The concentration profiles could be interpreted to reveal the effective diffusivities of the dyestuff within the liquid phase in the channel. These data were further interpreted in terms of the diffusivity of the liquid droplets in the gas core. It was found that the effective diffusivity of the liquid droplets was usually much less than the value calculated for eddy diffusivity in the gas phase flowing alone. The droplet diffusivity passed through a maximum at a position between the center of the tube and the wall. (auth)

30768 (SAN-651-57) ORGANIC RANKINE CYCLE TECHNOLOGY PROGRAM. Quarterly Progress Report No. 8, January 1–April 1, 1968. Niggemann, R. E. (Sundstrand Aviation-Rockford, Ill.). Apr. 15, 1968. Contract AT(04-3)-651. 85p. Dep. CFSTI.

Efforts during the period were devoted primarily to working fluid investigations, bearing investigations, pump investigations, and boiler investigations. The working fluid investigations are based on loop tests. Loops containing biphenyl or eutectic biphenyl–biphenyl ether mixtures have accumulated up to 6002 hr operating time at 650°F. In pump investigations angular contact ball bearings with Armalon cages were operated at design speed and load for 25 hr. A fatigue-type failure of several of the bearings caused unacceptable operation after 25 hr. During a 10-hr checkout operation of the loop pump test rig air inleakage in the low pressure plumbing and rotating alignment difficulties were encountered. Corrective measures are being developed in these areas. A shakedown run of the boiler test loop was conducted to correct plumbing and wiring difficulties. (J.R.D.)

30769 FLUORIDE SALTS FOR HEAT-TRANSFER APPLICATIONS. Litman, A. P.; McCoy, H. E.; DeVan, J. H. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 128-9(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30770 NUCLEAR STATION WASTE HEAT CAN EXTEND THE ST. LAWRENCE SEAWAY SEASON. Biggs, J. B. (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Trans. Amer. Nucl. Soc., 11: 3(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30771 HEAT TRANSPORT PUMPS. Renshaw, R. H. (Atomic Energy of Canada Ltd., Sheridan Park, Ont.). Trans. Amer. Nucl. Soc., 11: 7(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

Isotope Technology

Refer also to abstracts 30614, 30697, 30713, 30757, 31069, 31275, 32577, and 32578.

30772 (CONF-671112) PROGRAMME OF THE 8TH JAPAN CONFERENCE ON RADIOISOTOPES, NOVEMBER 13–16, 1967. Abstracts of Papers. 391p. Dep.

Abstracts of papers presented at the Eighth Japan Conference on Radioisotopes, November 13 to 16, 1967, are presented. Topics included are radioisotope equipment, radioisotope applications to flow problems, isotope applications in industry, radiation chemistry, waste disposal, irradiation facilities, accelerators, radiogaschromatography, genetics and breeding, microbiology, agriculture, clinical application of gamma cameras, nuclear medicine, radiation synthesis of chemicals, radioinduced modification of high polymers, radiation sources from the viewpoint of radiation chemistry, Moessbauer spectroscopy, radioisotope applications in life sciences, pesticide research, safety of radioisotopes and ionizing radiation, clinical applications of activation analysis, clinical use of ^{3}H- and ^{14}C-labeled compounds, clinical radioisotope units and their managements, instrumental analysis, application of activable tracers, food irradiation, biological effects of ionizing radiations, and measurement techniques. (B.G.D.)

30773 (DP-1155-1) ISOTOPIC POWER AND HEAT SOURCES. PART I. ^{60}Co. Quarterly Progress Report, January–March 1968. Hilborn, H. S. (comp.) (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Apr. 1968. Contract AT(07-2)-1. 17p. Dep. CFSTI.

Progress is reported on the evaluation of encapsulating materials for radioactive cobalt metal and on capsule fabrication and testing. It was found that operation of capsules at 1000°C for five years will not result in excessive diffusion of ^{60}Co in Hastelloy X, Hastelloy C, or Haynes 25. An Inconel 600 capsule containing nonradioactive cobalt was in satisfactory condition after 10,000 hours at 850°C. An Inconel 600 capsule containing radioactive cobalt was in satisfactory condition after 5000 hours at ~900°C. (auth)

30774 (ORNL-TM-2223(Pt.1)) SELECTED ABSTRACTS OF NON-U.S. LITERATURE ON PRODUCTION AND INDUSTRIAL USES OF RADIOISOTOPES. (From NSA January–March 1968). Gerrard, Martha; Baker, P. S. (Oak Ridge National Lab., Tenn.). May 1968. Contract W-7405-eng-26. 40p. Dep. CFSTI.

More than 250 abstracts of non-U. S. publications on production and use of radioisotopes and radiation, selected from the January–March 1968 issues of Nuclear Science Abstracts, are presented. (auth)

30775 (PAEC/Chem/Misc–2) APPLICATION OF GAMMA RADIATION FOR THE DETERMINATION OF BED LOAD IN FLUVIAL CHANNELS. Lodhi, M. A. (Atomic Energy Centre, Lahore (Pakistan)). Jan. 1967. 9p. Dep.

Methods by means of which bed load in hydraulic channels can be determined by the use of gamma emitting sources are described. These methods differ from the usual tracer techniques in the sense that a radioactive source is buried in the bed and the changes in the response of a suitably placed detector will be a function of the thickness or mass of the sand moving along the bed. (auth)

30776 (SC-CR-67-2801) SAFETY CHARACTERISTICS OF ^{210}Po. Willis, C. A.; Bramlitt, E. T.; Paulson, R. B.; Rooney, K. L. (Atomics International, Canoga Park, Calif.). Dec. 20, 1967. Contract AT(29-1)-789. 124p. Dep. CFSTI.

For Sandia Corp., Albuquerque, N. Mex.

The safety characteristics of ^{210}Po are investigated by evaluating the potential hazards from a 500,000-Ci source in a launch-pad abort. A launch-pad abort model is developed largely on the basis of Project Pyro data. Available experimental data and theoretical models are used to estimate polonium evaporation rates. The attachment of polonium to particles and smokes in the abort environment are evaluated using coagulation theory. Inhalation radiation doses are calculated using the International Commission on Radiological Protection model. The quantities of dusts that need to be injected into the cloud to provide various degrees of dose reduction are estimated. It was concluded that experimental data concerning polonium attachment to particles was needed to permit a realistic assessment of the hazards. (auth)

30777 NUCLEAR TECHNIQUES FOR WATER POLLUTION CONTROL IN SWEDEN. Ljunggren, Knut (Isotope Techniques Lab., Stockholm). Trans. Amer. Nucl. Soc., 11: 50(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30778 INTRODUCTION TO RADIOACTIVITY FOR ENGINEERS. Coombe, R. A. London, Macmillan, 1968. 176p. 35s.

Radioactivity, characteristics of radioactive decay, radioisotopes, physical properties of radiation, measurement of radiation-detectors, measurement of radiation-techniques, radioisotope measurements, radioisotopes in engineering measurement, industrial use of radioisotopes, scientific uses of radioisotopes, and safety with radioactive materials are subjects discussed. Worked examples and problems for solution are included. (UK)

30779 STUDIES ON THE APPLICATION OF RADIOISOTOPE TECHNIQUES IN STREAM POLLUTION PROBLEMS IN THE PULP AND PAPER INDUSTRY. Chatters, Roy M.; Peterson, Richard L.; Rice, Richard D. (Washington State Univ., Pullman). Trans. Amer. Nucl. Soc., 11: 51(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30780 LIGHT-WEIGHT RADIOISOTOPE THERMOELECTRIC GENERATOR SYSTEMS. Williams, John F. (Nuclear Materials and Equipment Corp., Apollo, Pa.). Trans. Amer. Nucl. Soc., 11: 88-9(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30781 DESIGN OF ISOTOPICALLY POWERED THERMOELECTRIC GENERATORS. Purdy, David L. (Nuclear Materials and Equipment Corp., Apollo, Pa.). Trans. Amer. Nucl. Soc., 11: 88(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30782 ^{238}Pu-POWERED CARDIAC PACEMAKER. Fleming, D. L.; Brewer, C. O.; Coffey, D. L.; Blue, P. L. (Mound Lab., Miamisburg, Ohio). Trans. Amer. Nucl. Soc., 11: 89-90(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30783 NEUTRON EMISSION RATES AND ENERGY SPECTRA OF TWO ^{238}Pu POWER SOURCES. Anderson, M. E.; Neff, R. A. (Mound Lab., Miamisburg, Ohio). Trans. Amer. Nucl. Soc., 11: 91(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30784 REFINING OF ^{238}Pu FOR BIOMEDICAL APPLICATIONS. Mullins, L. J.; Leary, J. A. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc., 11: 91-2(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30785 DESIGN AND DEVELOPMENT OF THE SNAP-23A ISOTOPE-POWERED TERRESTRIAL POWER GENERATION SYSTEM. Bernard, A. M.; Bifano, N. J.; Jackson, L. F.; Schmidt, J. E. (Westinghouse Astronuclear Lab., Pittsburgh). Trans. Amer. Nucl. Soc., 11: 17(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30786 USE OF A RADIOISOTOPE AS AN ELECTRON SOURCE IN A SPACE ENVIRONMENT SIMULATION CHAMBER. Lutz, R. F.; Newell, D. M. (Philco-Ford Corp., Palo Alto, Calif.). Trans. Amer. Nucl. Soc., 11: 22-4(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30787 USE OF RADIONUCLIDES IN INDUSTRY. Waechter, Karl Heinz (Frieseke and Hoepfner GmbH, Erlangen, Ger.). VDI (Ver. Deut. Ing.) Z., 110: 151-3(Feb. 1968). (In German).

The Laboratorium fuer die Isotopenanwendung in der Technik has the primary responsibility of conducting research to expand the use of radionuclides in industry. The uses of radionuclides in the textile industry and in measurement and control technology are summarized. The use of open radioactive materials is discussed. Irradiation installations and isotope batteries are briefly considered. 39 references. (J.S.R.)

30788 RECENT CALORIMETRIC DETERMINATIONS OF THE SPECIFIC POWERS AND HALF-LIVES FOR CERTAIN LONG-LIVED ALPHA-EMITTING RADIONUCLIDES. Oetting, F. L. (Dow Chemical Co., Golden, Colo.). pp 55-66 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

Calorimetric measurements of the specific powers of ^{232}U and ^{241}Am indicate that the measured specific power values are approximately 5% higher than the specific power values calculated from the respective half-lives. Calorimetric measurements on ^{240}Pu give a specific power which is higher by approximately 1% when compared with the specific power value calculated from its half-life. The calorimetric specific power for ^{239}Pu is slightly higher than the specific power as calculated from the half-life. The specific power determinations on these four isotopes were made on chemically pure materials in which the major isotopic constituent was the isotope in question. Two calorimeters were used in the investigation. A macro twin isothermal calorimeter was used to determine the specific power of ^{239}Pu and ^{241}Am with an accuracy of ±0.2%. A Calvet microcalorimeter was used to determine the specific power of ^{232}U and ^{240}Pu. Both calorimeters, although conventional, are described. More emphasis will be placed on a new technique used in the Calvet microcalorimeter where the power output is determined with an accuracy of better than ±0.1%. The measured specific powers of the four alpha emitting nuclides serve as an accurate correction for the heat effects in extensive thermochemical and thermodynamic investigations involving these four nuclides. These power measurements also result in half-life values which in some cases are radically different from the current or accepted value. (auth)

30789 RADIOISOTOPIC POWER SOURCES FOR HUMAN IMPLANTATION. Pennington, W. H. (Atomic Energy Commission, New York); Cole, D. W.; Mott, W. E. Isotop. Radiat. Technol., 5: 306-12(Summer 1968).

The U. S. Atomic Energy Commission, in cooperation with the National Heart Institute of the National Institutes of Health, is investigating the feasibility of developing a radioisotope-powered thermodynamic blood pump for an implantable circulatory support system. Conceptual design requirements as well as bioengineering problems and the candidate radioisotopes are discussed. (auth)

30790 ROUTINE INDUSTRIAL APPLICATIONS OF RADIOISOTOPES IN THE WORLD. Beswick, C. K. Isotop. Radiat. Technol., 5: 336-40(Summer 1968).

The extent to which radioisotope techniques have been accepted and are in current use is discussed. The use of radioisotopes in nuclear instruments, e.g., thickness gages, density of gages, relays and level gages, and moisture gages is summarized. The industrial application of radioisotopes in wear and lubrication studies, flow rate measurements, leak detection, ventilation, and pollutant dispersion studies is described. (R.C.K.)

30791 RE-ENTRY OF RADIOACTIVE POWER SOURCES. Brunner, M. J.; Dohner, C. V.; Lawit, R. L. (General Electric Co., Philadelphia). J. Spacecraft Rockets, 5: 448-53(Apr. 1968).

The characteristics and requirements for reentry vehicle systems are described for safe reentry of radioactive power sources. These systems must operate after exposure to long time thermal-radiative-vacuum environments and maintain the fuel intact and contained. Reentry conditions examined include random orbital decay through a range of trajectories from sub to superorbital. Present heat protection techniques utilizing standard ablation systems are useful for special short-lived applications. Techniques such as ablation/reradiation and transpiration cooling utilizing woven graphite fibrous materials show high potential for operational survival and ability to provide complete reentry protection. Future trends will stress recovery and "absolute" safety. (auth)

30792 ISOTOPES AND RADIATION TECHNOLOGY. Volume 5, Number 4. Baker, P. S.; Lafferty, Robert H. Jr.; Gerrard, Martha; Greene, R. E.; McKinney, F. E.; Carden, Joan E.; Miller, F. J.; Rupp, A. F. (eds.). One of the Four Technical Progress Reviews Published for the Division of Technical Information, USAEC. Oak Ridge, Tenn., Oak Ridge National Lab., Summer 1968. 80p. GPO $0.70.

Eighteen sections are included; separate abstracts were prepared for 17. The remaining miscellaneous sections includes brief information on conferences, availability of isotopes and services, and AEC activities. (P.C.H.)

For abstracts of individual papers see: 30713, 30758–30760, 30789, 30790, 30882–30884, 30976, 31008, 31047, 31098, 31155, 31311, 33201, and 33310.

30793 IMPROVED VACUUM PUMPING IN CALUTRONS. (to United States Atomic Energy Commission). British Patent 1,114,663. May 22, 1968. Priority date June 4, 1965, United States.

A system for increasing the ion output, providing better ion beam resolution, and lowering the background pressure in a calcutron is described. The system consists of a calcium boiler located in the ion source tank. The gettering action of the calcium vapor accomplishes the improved performance of the calutron. (W.H.K.)

Materials Testing

Refer also to abstracts 30813 and 32376.

30794 (CONF-680508-3) IN-REACTOR THERMIONIC CONVERTER TESTING EXPERIENCE AT GENERAL ELECTRIC. VanHoomissen, J. E.; Holtslag, D. J. (General Electric Co.; Pleasanton, Calif. Nuclear Thermionic Power Operation). [1966]. 10p. Dep. CFSTI.

From 2nd International Conference on Thermionic Electrical Power Generation, Stresa, Italy.

The design and testing of two single-cell fission powered thermionic converters is presented. Single-Cell In-Pile Test 509 (SCIP-509) contained a vent in the emitter clad which allowed fission gases to pass into the interelectrode space. Single-Cell In-Pile Test 510 (SCIP-510) had a sealed emitter clad structure which contained fission gases within the clad. Layouts and photographs of the hardware, operational current-voltage characteristics, and post-operational results are presented. (auth)

30795 (KY-549) TESTING OF FOURTEEN-TON URANIUM HEXAFLUORIDE CYLINDERS. Richardson, E. W.; Smith, V. A.; Bernstein, S. (Paducah Gaseous Diffusion Plant, Ky.). May 15, 1968. Contract W-7405-eng-26. 36p. Dep. CFSTI.

Destructive testing of large (14-ton) uranium hexafluoride shipping containers was performed. The structural properties of the two types of 14-ton thin-wall cylinders with the 10-ton thin-wall cylinders were compared. The results of all seven drop tests are reported. (auth)

30796 (ORNL-TM-1312(Vol.3)) STRUCTURAL ANALYSIS OF SHIPPING CASKS. VOL. 3. EFFECTS OF JACKET PHYSICAL PROPERTIES AND CURVATURE ON PUNCTURE RESISTANCE. Nelms, H. A. (Oak Ridge National Lab., Tenn.). June 1968. Contract W-7405-eng-26. 84p. Dep. CFSTI.

Thesis. Submitted to Univ. of Tennessee, Knoxville.

An experimental investigation was made of the puncture resistance of lead-shielded steel-jacketed shipping casks. This investigation concentrated on determining the effects of the material properties and the curvature of the cask jacket on puncture resistance. An empirical equation for prismatic casks was developed to relate the thickness of the jacket material necessary to resist puncture to the ultimate tensile strength of the jacket material and the weight of the cask. The equation developed was then compared with data previously obtained from tests with a prototype cask. A procedure for selecting the jacket thicknesses of cylindrical casks is outlined. (auth)

30797 (STI/DOC-10/81) RECURRING INSPECTION OF NUCLEAR REACTOR STEEL PRESSURE VESSELS. Technical Reports Series No. 81. Report of a Panel Held in Pilsen, Czechoslovak Socialist Republic 3–7 October 1966. (International Atomic Energy Agency, Vienna (Austria)). 1968. 248p. (CONF-661047). IAEA: $5.00; Austrian Schillings 130,-; £2.2.0; F Fr. 24,50; DM 20,-.

A total of fourteen papers was presented at the conference. A separate abstract was prepared for each of thirteen of the papers. One paper was previously abstracted in NSA as 22: 10430. (P.G.C.)

For abstracts of individual papers see: 30798–30809 and 31441.

30798 INSPECTIONS OF NUCLEAR REACTOR VESSELS FROM THE POINT OF VIEW OF NUCLEAR SAFETY. Iansiti, E. (Comitato Nazionale per l'Energia Nucleare, Rome). pp 15-27 of Recurring Inspection of Nuclear Reactor Steel Pressure Vessels. Vienna, International Atomic Energy Agency, 1968.

From Conference of Experts on Recurring Inspection of Nuclear Reactor Pressure Vessels, Pilsen, Czechoslovakia. See STI/DOC-10/81; CONF-661047.

The different functions which a pressure vessel performs in a nuclear plant are discussed, the role of a pressure vessel as a support of the control equipment and of the reactor core being stressed. An idea is given of the reliability which is required of a pressure vessel from the nuclear safety point of view and which should be ensured by an appropriate inspection and control system. A short review of Italian activity in the field of inspections and control of materials, with particular emphasis on control during the life of the plant, is also presented. The possibility of performing regular overpressure tests on different types of nuclear plants is discussed, particular consideration being given to testing methods and nuclear safety requirements. (auth)

30799 PRESENT VIEWS ON RECURRING INSPECTION OF REACTOR PRESSURE VESSELS IN THE FEDERAL REPUBLIC OF GERMANY. Kellermann, O. (Institut fuer Reaktorsicherheit, Cologne). pp 5-13 of Recurring Inspection of Nuclear Reactor Steel Pressure Vessels. Vienna, International Atomic Energy Agency, 1968.

From Conference of Experts on Recurring Inspection of Nuclear Reactor Pressure Vessels, Pilsen, Czechoslovakia. See STI/DOC-10/81; CONF-661047.

Examples are given to show the value of recurring inspections in conventional installations. It is shown that a basis for the choice of suitable testing methods and of the extent of the tests can be obtained by analyzing the factors which tend to decrease the strength of a reactor pressure vessel. Some basic conditions must be fulfilled for optimal evaluation of a visual inspection of the inner surface of the vessel. Acoustic and thermic methods for non-destructive tests should be developed further. One section of the recent standard proposal "Recurring Inspections in Reactor Installations" is discussed to demonstrate present trends in the Federal Republic of Germany. (auth)

30800 PROBLEMS IN THE SURVEILLANCE OF STEEL REACTOR VESSELS. Costes, D. (Commissariat a l'Energie Atomique, Saclay, France). pp 29-38 of Recurring Inspection of Nuclear Reactor Steel Pressure Vessels. Vienna, International Atomic Energy Agency, 1968.

From Conference of Experts on Recurring Inspection of Nuclear Reactor Pressure Vessels, Pilsen, Czechoslovakia. See STI/DOC-10/81; CONF-661047.

The importance of appropriate design of steel vessels is stressed, together with the necessity for correct manufacturing and careful inspection after fabrication. It is pointed out that the prescribed conditions for utilization of the vessel should be observed. Development of continuous or periodic inspection methods to discover cracks in vessels during operation is recommended in view of the catastrophic consequences of a rupture. The extrapolation of results from tests of small samples is examined, together with ultrasonic inspection, permanent sonic testing and periodic overpressure tests. Some safety comparisons between steel and prestressed concrete vessels are presented. (auth)

30801 RECURRING INSPECTIONS OF STEEL REACTOR PRESSURE VESSELS IN SWEDEN. Edling, G. (Swedish Steam Users' Association, Stockholm). pp 39-42 of Recurring Inspection of Nuclear Reactor Steel Pressure Vessels. Vienna, International Atomic Energy Agency, 1968.

From Conference of Experts on Recurring Inspection of Nuclear Reactor Pressure Vessels, Pilsen, Czechoslovakia. See STI/DOC-10/81; CONF-661047.

Procedures and methods designed to ensure maximum safety, operational stability and long reactor lifetime are discussed. It is noted that inspection and control during design, manufacture and preoperational testing should be mandatory as should an extensive and detailed report of the testing. Recurring inspection should be performed and provisions for this type inspection should be incorporated in the pressure vessel design. Weld material and metal from the heat-affected zone should be sampled and tested periodically. (P.G.C.)

30802 PROPERTIES AND FLAWS WHICH MAY AFFECT THE PERFORMANCE OF NUCLEAR REACTOR VESSELS. Wylie, R. D. (Southwest Research Inst., San Antonio). pp 43-59 of Recurring Inspection of Nuclear Reactor Steel Pressure Vessels. Vienna, International Atomic Energy Agency, 1968.

From Conference of Experts on Recurring Inspection of Nuclear Reactor Pressure Vessels, Pilsen, Czechoslovakia. See STI/DOC-10/81; CONF-661047.

The mechanisms of failure in steel reactor pressure vessel are reviewed. Aspects considered include as-fabricated properties and initial flaws, service failure mechanisms, radiation induced changes, inspection points and inspection methods, and designing for in-service inspection. Ten references are included. (P.G.C.)

30803 DEVELOPMENTS IN THE PERIODIC INSPECTION OF PRIMARY CIRCUIT PRESSURE COMPONENTS OF NUCLEAR REACTORS. Irvine, W. H. (United Kingdom Atomic Energy Authority, Risley, Eng.). pp 61-72 of Recurring Inspection of Nuclear Reactor Steel Pressure Vessels. Vienna, International Atomic Energy Agency, 1968.

From Conference of Experts on Recurring Inspection of Nuclear Reactor Pressure Vessels, Pilsen, Czechoslovakia. See STI/DOC-10/81; CONF-661047.

Techniques such as operational strain measurement, indirect viewing, and material monitoring for the periodic inspection of the reactor vessel shell are briefly described. Methods of establishing reactor pressure component integrity based on fracture mechanics are currently being developed. This approach and its implications in relation to the procedures described earlier are discussed. (auth)

30804 OPERATIONAL SAFETY OF PRESSURE VESSELS AT CZECHOSLOVAK NUCLEAR POWER STATIONS. Brumovsky, M.; Filip, R.; Indra, J.; Kalna, K.; Komarek, A. (Skoda Works, Pilsen, Czechoslovakia). pp 73-90 of Recurring Inspection of Nuclear Reactor Steel Pressure Vessels. Vienna, International Atomic Energy Agency, 1968.

From Conference of Experts on Recurring Inspection of Nuclear Reactor Pressure Vessels, Pilsen, Czechoslovakia. See STI/DOC-10/81; CONF-661047.

Calculation procedures, designs and experimental activities to ensure the operational safety of pressure vessels in Czechoslovak nuclear power stations are surveyed. The program of activities is divided into two parts. The first concerns pre-operational stages, considerations during pressure vessel design and layout and, in particular, allowable stresses. Extensive experimental work was performed to verify and define the limit state of material under operational conditions. The second part of the program will be performed during reactor pressure vessel operation and is intended to determine the precise regime and lifetime for the whole reactor vessel. (auth)

30805 FABRICATION AND RECURRING INSPECTION OF NUCLEAR REACTOR STEEL PRESSURE VESSELS IN JAPAN. Ando, Y. (Tokyo Univ.); Fujimura, T.; Matsumiya, J.; Onodera, S. pp 91-128 of Recurring Inspection of Nuclear Reactor Steel Pressure Vessels. Vienna, International Atomic Energy Agency, 1968.

From Conference of Experts on Recurring Inspection of Nuclear Reactor Pressure Vessels, Pilsen, Czechoslovakia. See STI/DOC-10/81; CONF-661047.

Experience in the construction of steel pressure vessels for water-cooled and gas-cooled reactors in Japan is reported. Irradiation embrittlement, the detection of possible defects, the initiation and arresting of brittle fracture and the spreading of fatigue cracks are discussed. Experience in test programming, the results of inspections performed, and general problems with reactor pressure vessels are reviewed. In addition, some basic studies now in progress on brittle fracture and low cycle fatigue of pressure vessels are described. (auth)

30806 MORE RATIONAL TESTING OF STEELS USED IN PRESSURE VESSELS. Soete, W. (Univ. of Ghent). pp 129-45 of Recurring Inspection of Nuclear Reactor Steel Pressure Vessels. Vienna, International Atomic Energy Agency, 1968.

From Conference of Experts on Recurring Inspection of Nuclear Reactor Pressure Vessels, Pilsen, Czechoslovakia. See STI/DOC-10/81; CONF-661047.

It is proposed that tensile or bend tests be performed on wide plates with fatigue cracks through or partly through the steel as delivered and the steel as used in the vessel. Welds can be controlled with tensile or bend tests parallel to the butt weld of wide plates cracked in the heat-affected zone. Research is in progress to define the remaining ductility in a steel after a well defined embrittlement and the required ductility for all mechanical or thermal treatments carried out during construction and service. (auth)

30807 IMPORTANCE OF THE HEAT-AFFECTED ZONE WITH REGARD TO EMBRITTLEMENT OF THE PRESSURE VESSEL DURING FABRICATION AND OPERATION. Sebille, J. (EURATOM, Brussels). pp 193 of Recurring Inspection of Nuclear Reactor Steel Pressure Vessels. Vienna, International Atomic Energy Agency, 1968.

From Conference of Experts on Recurring Inspection of Nuclear Reactor Pressure Vessels, Pilsen, Czechoslovakia. See STI/DOC-10/81; CONF-661047.

The HAZ (heat-affected zone) may undergo embrittlement during fabrication (welding and/or stress relief). This phenomenon is due, not only to grain coarsening, but also to the combined effects of deformation, temperature, microstructure, and composition. The embrittlement is locally detectable by a lowering of impact strength and an impact transition shift. In some cases it is not suppressed by the stress-relief heat treatment and may represent a real danger, since the pressure vessel presents weak points where irradiation may induce conditions prone to produce cracks. The microstructure of the HAZ being more or less of the "quenched" type, stress relief can also produce embrittlement if the steel is susceptible to temper embrittlement. Even if the HAZ does not appear to be a preferential area for ruptures, e.g., from the results of Robertson tests, the additional embrittlement due to irradiation may cause microcracks that could spread later. It must also be noted that the irradiation behavior of the HAZ is very little known and that the available results are sometimes contradictory, so that more research work must be done in this area. Moreover, there is some indication that radiation damage is more difficult to "anneal out" in the HAZ than in the unwelded steel plate. The paper associated with this abstract is not included in the report series. (auth)

30808 OPERATIONAL AND INSPECTION PROBLEMS OF NUCLEAR REACTOR PRESSURE VESSELS. Vinck, W. (EURATOM, Brussels). pp 195-8 of Recurring Inspection of Nuclear Reactor Steel Pressure Vessels. Vienna, International Atomic Energy Agency, 1968.

From Conference of Experts on Recurring Inspection of Nuclear Reactor Pressure Vessels, Pilsen, Czechoslovakia. See STI/DOC-10/81; CONF-661047.

Data resulting from the experience of Euratom in reactor safety analysis work done jointly with national organizations are summarized. Internal inspection of nuclear vessels appears more and more necessary as experience is accumulated. The extreme difficulty of performing such inspections calls for development of adequate inspection methods. Attention should be paid to internals in view of the damage they could cause to the vessel. It is suggested that the possibility of adopting a corrosion surveillance program be examined. It is recalled that Euratom not only sponsors research and development programs on steels and pressure vessel fabrication, but also gives much attention to experimental programs on crack propagation in test vessels. (auth)

30809 ANALYSIS OF SOME FACTORS AFFECTING THE OPERATIONAL SAFETY OF STEEL REACTOR PRESSURE VESSELS AND OF THE POSSIBILITIES OF RECURRING INSPECTION. pp 199-212 of Recurring Inspection of Nuclear Reactor Steel Pressure Vessels. Vienna, International Atomic Energy Agency, 1968.

From Conference of Experts on Recurring Inspection of Nuclear Reactor Pressure Vessels, Pilsen, Czechoslovakia. See STI/DOC-10/81; CONF-661047.

The value of periodic inspection to operational reliability of steel reactor pressure vessels is discussed. Aspects considered include effects of design, quality of material, fabrication methods, and radiation effects on creep, corrosion, fatigue, and embrittlement. 37 references are cited. (P.G.C.)

Radioactive Material Handling

Refer also to abstracts 30750, 30766, 30795, and 30796.

30810 (KY-546) THE DESIGN, FABRICATION AND TESTING OF A QUARTER SCALE MODEL OF THE DEMONSTRATION URANIUM FUEL ELEMENT SHIPPING CASK. Clifford, C. B. (Paducah Gaseous Diffusion Plant, Ky.). June 10, 1968. Contract W-7405-eng-26. 54p. Dep. CFSTI.

The design criteria, engineering drawings, manufacturing techniques, and instrumentation used in fabricating, testing, and evaluating a quarter scale model of the "Demonstration Fuel Element Shipping Cask from Laminated Uranium Metal" are presented. The model was designed and fabricated to represent the major structural features of the demonstration fuel element cask, without incurring the additional costs associated with installing heat transfer fins or machining unnecessary penetrations through the walls. The cavity and outside cylindrical stainless steel cladding was coated with brittle lacquer, and a closure edge drop test was made from a height of 40 inches to determine the stress patterns developed in the cladding. Precision measurements made on the model, before and after the drop test, showed a number of weaknesses in the 30° set screw closure design. Therefore, all fabrication work was stopped on the closure end of the demonstration fuel element cask until the model was redesigned and the revised model was drop tested. Electrical accelerometers, strain gauges, and thermocouple instrumentation were used during various phases of the testing program, and black and white and color photography was used to document each test. Three types of drop tests were made on an essentially flat and unyielding surface prior to fire testing the unit for 30 minutes at a temperature of approximately 1500°F. (auth)

30811 (NYO-9653) EFFECTS OF AN ELEVATED TEMPERATURE AND PRESSURE ENVIRONMENT UPON VITREOUS FUSIONS CONTAINING RADIOACTIVE WASTES. Touhill, C. J.; Ketcham, D. L.; Eliassen, R. (Massachusetts Inst. of Tech., Cambridge. Sedgwick Labs. of Sanitary Science). Aug. 31, 1961. Contract AT(30-1)-621. 92p. Dep. CFSTI.

A combination of calcination, fixation in vitreous matrices, and subsequent storage of radioactive wastes in salt formations is described as a practical method of ultimate disposal of such wastes. The effects of elevated temperatures, cooling methods, and leaching on the glasses containing radioactive wastes are discussed. It was found that temperature produced 6.82 cpm. When water was present at the temperature tested, 1659.03 cpm were obtained. It was found that only 0.41% of the leaching would occur due to temperature effects alone. It was concluded, therefore, that glass when stored in a sealed space requires water for excessive leaching to occur. (R.C.K.)

30812 PROPERTIES OF SALT IMPORTANT IN RADIOACTIVE WASTE DISPOSAL. Bradshaw, R. L.; Empson, F. M.; Boegly, W. J. Jr.; Kubota, H.; Parker, F. L.; Struxness, E. G. (Oak Ridge National Lab., Tenn.). Geol. Soc. Amer., Spec. Pap. 88, 643-59(1968).

The Oak Ridge National Laboratory has for several years been conducting tests relating to ultimate disposal of highly radioactive power reactor wastes in salt mines. A number of laboratory and field tests have been conducted on properties of salt which are important in the design and operation of a waste-disposal facility. In situ heat transfer properties are sufficiently close to the values determined in the laboratory that confidence can be placed in theoretical heat-transfer calculations. Most bedded salt contains trapped moisture which is released with violence at temperatures above about 250°C. Radiation exposure doses of 5×10^8 roentgens produce some changes in structural properties, but the effect on mine stability should be negligible. Rock salt is approximately equivalent to concrete as a gamma-radiation shield. Stability of a waste-disposal mine at ambient temperature can be predicted from observed conditions in existing salt mines. Elevated temperatures will cause accelerated creep, but the exact effects on structural stability cannot yet be predicted accurately. (auth)

30813 METHODS FOR THE ASSESSMENT OF PACKAGING FOR THE TRANSPORT OF RADIOACTIVE MATERIALS. PART 2. FISSILE MATERIALS AND LARGE SOURCES. British Standard 3895, Part 2, 1968. London, British Standards Institution, 1968. 63p. 20s.

Additional vibration and pressure tests, relating to the containment vessel, which are not included in Part 1 of the Standard, are recommended, with special application to the design of packaging for fissile materials and large radioactive sources. Account is taken of the work by the IAEA Panels, and revised IAEA requirements. (UK)

Vacuum Engineering

Refer also to abstract 30793.

30814 OPERATING CHARACTERISTICS OF TWO-ELECTRODE GETTER ION PUMPS AT VERY LOW PRESSURES. Dallos, A.

Thesis.

Pumping rates in the 10^{-6} to 10^{-11} torr pressure range were determined for H_2, N_2, and He. The pumping rate measurements were made at different pressures, the latter being kept constant for each experiment. The obtained curves consist of a constant part to which an exponentially decreasing part is added. An extremely simplified model is presented on the assumption that the exponential part of the pumping speed is due to a saturation effect of the sorbent, the part invariable in time being the result of a constant density of contamination on the surface, brought about by the combined action of sputtering and of diffusion into the bulk metal. The number of pumped gas particles per unit charge was found to differ for the various gases but was independent of the period of pumping. The current vs pressure function was also found to be independent of time and different for the three gases quoted above. Over and below approximately 10^{-9} torr these curves are nearly linear but their slopes are not identical, they show marked deviation from linearity in the 10^{-8} to 10^{9} torr range. In order to increase the pumping rate it was concluded that the injection of electrons in addition to those emitted by the cold cathodes would be a useful improvement; this was experimentally verified at 3×10^{-9} torr. The incorporation of a radioactive ionization source into the design of the pump has been suggested. (Hung. Tech. Abstr.)

30815 PHYSICAL PRINCIPLES OF ULTRAHIGH VACUUM SYSTEMS AND EQUIPMENT. Robinson, N. W. London, Chapman and Hall, 1968. 280p. 75s.

Pressures $<10^{-8}$ torr are specifically dealt with. Main headings are as follows: measurement of pressure in the ultrahigh vacuum range; pumping by ionization, sorption and cryogenics; fundamental principles of mechanical appliances in ultrahigh vacuum; mass spectrometry; principles of leak detection; residual gases in ultrahigh vacuum systems; adsorption phenomena; transfer of gases at ultrahigh vacuum; degassing phenomena and preparation of clean surfaces. (UK)

30816 VACUUM PUMPING METHOD AND APPARATUS. Milleron, Norman (to United States Atomic Energy Commission). U. S. Patent 3,383,032. May 14, 1968.

High vacuum evacuation means featuring a beam of electrons impinged upon a continuously moving target comprising a conductive material having a vapor pressure of less than about 10^{-10} torr is described. The impinging electrons serve to increase the gas adsorption, or "gettering," affinity of the target material. (AEC)

30817 EXPERIMENTAL TEST OF SURFACE PHASE THEORY FOR ULTRAHIGH VACUUM SYSTEMS. Earnshaw, J. W.; Hobson, J. P. (National Research Council, Ottawa). J. Vac. Sci. Technol., 5: 19-22(Jan.-Feb. 1968).

Experiments are described which test the surface phase theory for ultrahigh vacuum systems. Tests were performed on a system containing 3×10^{-9} Torr of argon in equilibrium with a physically adsorbed phase at 77°K. The surface phase theory is used to estimate parameters of the system (e.g., pumping speed, leak rate, quantity of gas in a physically adsorbed phase) and then estimates are compared with direct observations. Variations of the pressure of argon in this system are compared with those of carbon monoxide at room temperature in the same system. The generality of the surface phase process for many gases in vacuum systems is discussed. (auth)

30818 ULTRAHIGH VACUUM GAUGE CALIBRATION. Davis, William D. (General Electric Research and Development Center, Schenectady, N. Y.). J. Vac. Sci. Technol., 5: 23-33(Jan.-Feb. 1968).

A study was made of the problems associated with the operation and calibration of vacuum gauges at pressures below 10^{-10} Torr, particularly the hot-cathode magnetron gauge developed by Lafferty. A liquid-He pumped metal vacuum system was used to attain base pressures of 1×10^{-13} Torr. Calibration pressures were generated by molecular flow through known conductances using a McLeod gauge as the pressure standard. Under proper operating conditions, the output of the hot-cathode magnetron showed no deviation from linearity down to the base pressure of the system. Calibration curves were also obtained for a General Electric cold-cathode gauge and a mass spectrometer. (auth)

INSTRUMENTATION

Radiation Detection Instruments

General Detectors and Monitors

30819 (ARH-488) AN ALPHA, BETA-GAMMA SINGLE CHASSIS SURVEY INSTRUMENT. Campbell, M. L.; Garland, T. R. (Atlantic Richfield Hanford Co., Richland, Wash.). Feb. 21, 1968. Contract AT(45-1)-2130. 12p. (CONF-680425-1). Dep. CFSTI.

From Conference on Technology Utilization, Seattle, Wash.

By introducing a small flow of methane into a standard air proportional poppy probe, a high efficiency, low energy beta and a much improved alpha survey instrument was developed. The methane gas poppy probe (MGP) was found to be more sensitive to all energies of beta than either of the standard survey instruments routinely used (mica window and standard GM). A factor of eighteen in surface area drastically lowers the time of survey and minimizes missing point source contamination. This modification is made on existing equipment, improving that equipment for its original purpose, and adds a very sensitive low energy beta survey probe in a single chassis, for less than a total expenditure of $50.00. (auth)

30820 (NLCO-1011) A SELF-CORRECTING INSPECTION MONITOR FOR DETERMINING THE ^{235}U LEVEL IN REACTOR FUEL CORES. Twitty, B. L.; Humphrey, H. W. (National Lead Co. of Ohio, Cincinnati). May 1968. Contract AT(30-1)-1156. 10p. Dep. CFSTI.

A self-correcting gamma ray monitor was designed to measure the ^{235}U isotopic levels of uranium fuel cores nondestructively in routine final inspection of production. The instrument automatically corrects for ^{238}U decay product interferences and for large temperature and voltage fluctuations. The monitoring operation is performed by production personnel. In three years of continuous operation, a precision of ±0.05 wt % ^{235}U at the 95% C. L. has been maintained in the 0 to 5 wt % range. The monitors have proven to be highly reliable and have required little maintenance. Various types of nondestructive monitors are compared and, on the basis of speed of analysis, precision of results, complexity for production workers, and equipment cost, the system developed here is shown to be the one that most adequately meets the production inspection requirements at this site. (auth)

30821 (ORNL-TM-1638(Pt.17)) NUCLEAR INSTRUMENT MODULE MAINTENANCE MANUAL. PART 17. FISSION CHAMBER AND PREAMPLIFIER DC POWER SUPPLY, ORNL MODEL Q-2617-5. Anderson, J. L. (Oak Ridge National Lab., Tenn.). Mar. 13, 1968. Contract W-7405-eng-26. 19p. Dep. CFSTI.

The fission chamber and preamplifier dc power supply provides three regulated output voltages from an unregulated input supply of −32 ± 4 V dc for use with the fission chamber and preamplifier assembly, ORNL model Q-2617-1. The three outputs are: +300 V dc for polarization of the fission chamber, +110 V dc for the preamplifier anode supply, and −22 V dc for the preamplifier vacuum tube heaters and for biasing. The supply is fabricated in a standard three-unit plug-in module of the ORNL Modular Reactor Instrumentation Series. The circuit, applications, maintenance procedures, and acceptance tests for the power supply are described. (auth)

30822 (ORNL-TM-2153) MULTIANALYZER STORED PROGRAM DATA ACQUISITION SYSTEM INTERFACE. Madden, E. (Oak Ridge National Lab., Tenn.). Mar. 27, 1968. Contract W-7405-eng-26. 31p. Dep. CFSTI.

An interface was constructed so that a Digital Equipment Corporation PDP-8 computer could be used as the experiment and data acquisition controller for a charged-particle detector system employing three solid-state detectors and flight-time analysis. The system is designed for use as a magnetic-tape analyzer. The system interface design concepts and details, input and output circuits and connections, interface operation requirements, and modifications to existing hardware are discussed. This system has been operational for more than 1 year. (auth)

30823 (RISO-M-678) ELEKTRISK UDSTYR TIL JUSTERING OG KONTROL AF IONISERINGSKAMRE. (Electronic Device for Adjustment and Control of Ionization Chambers). Skanborg, P. Z.; Jensen, P. Steen (Danish Atomic Energy Commission, Risoe. Research Establishment). Feb. 1968. 18p. (In Danish). Dep.

An electronic device suitable for adjustment and control of monitors using ionization chambers is described. The necessary test current appears when the chamber voltage is increased linearly with time. (auth)

30824 (SLAC-Trans-81) CALCULATION OF LINEAR ENERGY TRANSFER OF VARIOUS TYPES OF RADIATION IN LIQUIDS USABLE AS FILLING IN IONIZATION CHAMBERS. Mathieu, Jacques; Patau, Jean-Paul; Blanc, Daniel. Translated for Stanford Linear Accelerator Center, Calif., from Health Phys., 14: 141-9(1968). 20p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

This item was previously abstracted from the original language and appeared in NSA as 22: 16879. (B.G.D.)

30825 (UCRL-50007-67-3) HAZARDS CONTROL PROGRESS REPORT NO. 29 (SEPTEMBER-DECEMBER 1967) AND INDEX TO HAZARDS CONTROL PROGRESS REPORTS NOS. 27 THROUGH 29. (California Univ., Livermore. Lawrence Radiation Lab.). 67p. Dep. CFSTI.

Topics discussed include supralinearity and optical absorption in lithium fluoride crystals for thermoluminescent dosimetry, an x-ray survey meter for plutonium contamination, alpha water monitoring by low energy x-ray detection, a solid-state beta dosimetry system, a portable microcalorimeter for measuring absorbed radiation dose, flying air sampler, temperature profile measurements of the lower atmosphere using the T-Sonde, and the halide meter. (W.H.K.)

30826 DESIGN AND PERFORMANCE OF A LOW-COST FISSION-PRODUCT MONITOR SYSTEM. Feltz, D. E.; Randall, J. D.; Bates, E. F.; Sandel, P. S. (Texas A and M Univ., College Station). Trans. Amer. Nucl. Soc., 11: 272-3(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30827 RADIOACTIVE RADIATION COUNTER. Perelman, Simon Meerovich; Prager, Isaak Aronovich; Gastev, Jury Alexandrovich; Tolmachev, Anantoly Felippovich; Klebanov, David Lvovich (to Moscovsky Elektrolampovy Zavod). British Patent 1,114,137. May 15, 1968. Filed Aug. 20, 1965.

An ionization chamber which can be used at high temperatures without an auxiliary cooling system is described. The components of the counter are made of materials having a work function of at least 3.5 eV up to 350°C and TK-100 not less than 475°C, where TK-100 is the temperature at which the electrical resistivity of the material is equal to 10^8 ohm cm. An $Al_2O_3-BaO-CaO-SiO_2-ZnO$ glass is used for the envelope and internal insulators. (W.H.K.)

30828 VERSATILE GAMMA-RAY CAMERA FOR DYNAMIC OR STATIC ISOTOPE STUDIES. Moody, N. F.; Paul, W.; Joy, M. (Univ. of Toronto). Trans. Amer. Nucl. Soc., 11: 64(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30829 ADVANCES IN POSITRON SCANNING. Brownell, Gordon L.; Wilensky, Samuel; Burnham, Charles; Aronow, Saul (Massachusetts General Hospital, Boston). Trans. Amer. Nucl. Soc., 11: 64-5(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30830 DEVELOPMENT OF A SENSITIVE GAMMA COUNTER DIRECT-READING IN FLUX AND DOSE RATE. Ozair, V.; Andrews, D. G. (Univ. of Toronto). Trans. Amer. Nucl. Soc., 11: 66-7(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30831 COMPARATIVE STUDY OF DIFFERENT TYPES OF DETECTORS AND SOURCES FOR ISOTOPE X-RAY SPECTROMETRY APPLIED TO THE ANALYSIS OF BINARY AND TERNARY SYSTEMS. Donhoffer, D. K. (Atomic Energy of Canada Ltd., Ottawa). Trans. Amer. Nucl. Soc., 11: 67-8(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30832 ANALYSIS OF THE GAMMA NOISE EXPERIMENT BY THE LANGEVIN'S TECHNIQUE. Lehto, Wayne K. (Argonne National Lab., Idaho Falls, Idaho); Carpenter, John M. Trans. Amer. Nucl. Soc., 11: 235-6(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30833 ADJOINT-WEIGHTED DETECTOR EFFICIENCY FOR NEUTRON NOISE EXPERIMENTS. Congdon, M. E.; Albrecht,

R. W. (Univ. of Washington, Seattle). Trans. Amer. Nucl. Soc., 11: 233-4(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30834 PROCEDURE FOR THE DETERMINATION OF NEUTRON SPECTRA FROM ACTIVATION DATA. Greer, C. L. (Bellcomm, Inc., Washington, D. C.); Halbleib, J. A.; Walker, J. V. Trans. Amer. Nucl. Soc., 11: 211-12(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30835 FLUX MEASUREMENT WITH DAMAGE TRACK DETECTORS. Cross, W. G. (Atomic Energy of Canada Ltd., [Ottawa]). Trans. Amer. Nucl. Soc., 11: 416(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30836 SELF-ABSORPTION CORRECTIONS IN PHOTOPEAK ANALYSIS OF GAMMA PHOTONS FROM NUCLEAR EMISSION AND POSITRON ANNIHILATION IN 14-MeV NEUTRON ACTIVATION ANALYSIS. Crambes, M. R.; Nargolwalla, S. S.; Suddueth, J. E. (National Bureau of Standards, Washington, D. C.). Trans. Amer. Nucl. Soc., 11: 97-8(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30837 RECENT ADVANCES IN REGENERATIVE IN-CORE NEUTRON FLUX MONITORS. Jackson, Charles N. Jr. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc., 11: 336(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30838 THE FISSION-COUPLE DETECTOR: A LOW-RESOLUTION NEUTRON SPECTROMETER FOR PULSED-NEUTRON ENVIRONMENTS. Posey, L. D.; Walker, J. V. (Sandia Corp., Albuquerque, N. Mex.). Trans. Amer. Nucl. Soc., 11: 342-3 (June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30839 OUT-OF-CORE DETECTOR RESPONSE TO ARBITRARY POWER SHAPES. Levine, Melvin M. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc., 11: 307-8(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30840 VACUUM X-RAY SPECTROMETER. Trapeznikov, V. A.; Nemnonov, S. A. (Inst. of Metal Physics, Kiev). Fiz. Metal. Metalloved., 25: 57-61(Jan. 1968). (In Russian).

The latest model of a vacuum x-ray spectrometer with ionization registration of the radiation is described. A series of adaptations for the spectrometer is also discussed. (tr-auth)

30841 RADIATION IMAGING DEVICE. Lofstrom, James Ernst; Horwitz, Norman Hirsch. British Patent 1,114,352. May 22, 1968. Priority date Apr. 2, 1965, United States.

A radioisotope scanner for mapping the distribution of radioisotopes in human organs is described. The system consists of a laminated collimator, a photosensitive cathode, and a transparent anode with a fluorescent coating. An electric potential is maintained between the anode and cathode, and a gas filling is located between the anode and cathode to support discharge due to photoelectrons from the cathode. (W.H.K.)

30842 RADIATION STABILITY OF ZnS(Ag) CRYSTAL WHEN EXPOSED TO CHARGED-PARTICLE IRRADIATION. Sokolovskaya, T. I.; Krainyukov, N. I.; Nikulina, R. A.; Tsirlin, Yu. A. (VNII of Single Crystals, Kharkov). Prib. Tekh. Eksp., No. 6, 39-40(Nov.-Dec. 1967). (In Russian).

The effect of irradiation by α-particles and by electrons of varying intensity on the luminescence yield L of ZnS(Ag) crystals was investigated. Two ZnS(Ag) specimens with areas of 4×9 mm^2 and 8×9 mm^2 and 0.5 mm high were irradiated with α-particles in three experiments using fluxes 300, 500, and 20,000 particles/cm$^2 \cdot$ sec. Experiments demonstrated that there is no noticeable decrease in resistance to irradiation during 24 hours of exposure to α-particles. Test results from the electron irradiation of a ZnS(Ag) specimen are shown in Fig. 1. Low-energy electron fluxes of 5×10^3, 11×10^3, and 70×10^3 particles/cm^2 sec were used to study resistance to irradiation. Test results are shown by curves a and b. The graph demonstrates that a decrease in specimen luminescence yield occurs only during exposure to very dense electron fluxes (b). Luminescence yield from the specimen was not restored for 3 hours. Similar damage occurred during exposure to electron fluxes with $7 \cdot 10^3$ particles/cm^2 sec obtained from a ^{137}Cs source with an energy of 624 keV; results are represented by Curve c. It was concluded that specimen luminescence yield does not change during exposure to α-particles, but it does change during irradiation by electron fluxes of comparatively high density. Orig. art. has: 1 figure. (ATD)

30843 AIR MONITOR FOR ^{239}Pu (Engineering Materials). (Dow Chemical Co., Midland, Mich.). (CAPE-1728).
2 drawings.

An air monitor is described which permits continuous sampling procedures for Pu-239. The monitor is compact and economical and uses a semiconductor detector for sensing α emitting contamination. The air-sampling arrangement consists of a flow meter and assembly to permit quick filter changes; a line-powered, transistorized amplifier and count-rate circuit; a count-rate meter; a warbling circuit; and recorder connections if needed. (For details see TID-4100.) (F.S.)

30844 DETECTION MECHANISM IN SEMICONDUCTOR COUNTERS. Deshpande, R. Y. (Bhabha Atomic Research Centre, Trombay, India). pp 379-400 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.
See CONF-670220-(Vol.2).

An attempt is made to present a consistent picture of the detection mechanism in junction-type semiconductor counters. The processes of energy loss, of creation of charge pairs, of charge separation and collection, and of signal formation in the presence of background noise, are briefly reviewed. Shockley's simple model accounting for ϵ, and van Roosbroeck's calculation of Fano factor, are first described. While comparing the theory with the experimental results it is suggested that further definition of the threshold energy is necessary. It is also pointed out that the branching process of energy loss, in contrast to the collective loss mechanism, needs further theoretical clarification. Then, the several factors which affect the charge separation and collection are discussed. At this stage the leakage of excess charge by dielectric relaxation in the detector medium is also considered. Next, the statistical processes influencing the energy resolution are quickly described. An illustrative calculation for diffused silicon detectors, for which complete data is now available, is then performed. In this context the role of surface properties is also considered. Finally, the possibility of developing a proportional solid-state detector is hinted. (auth)

30845 SOME OBSERVATION ON THE SCINTILLATION PERFORMANCE CHARACTERISTICS OF SODIUM IODIDE THALLIUM ACTIVATED CRYSTALS. Bhide, G. K.; Ramamurthy, G. V. N.; Karandikar, S. C. pp 570-6 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.
See CONF-670220-(Vol.2).

Performance characteristics—photo peak pulse heights and full width of the photo peak at half the maximum counting rate (FWHM)—of 105 sodium iodide scintillators of identical dimensions, grown in the laboratory, were reviewed. As uncertainties involved in the measurements on sodium iodide are many in view of its hygroscopic nature, a large number of observations was presented. The results indicate that large pulse height and good FWHM, which are prerequisites of the scintillator for its utility in spectrometric applications, depend on a number of factors relating to the activator distribution in the host crystals. (auth)

30846 EKSPERIMENTAL'NYYE METODY YADERNOY FIZIKI. [vyp.] 1: DETEKTORY ELEMENTARNYKH CHASTITS. (Experimental Methods in Nuclear Physics. No. 1. Elementary Particle Detectors). Kalashnikova, Valentina Ivanova; Kozodaev, Mikhail Silich. Moscow, Izdatel'stvo Nauka, 1966. 407p.

This textbook is intended for physics and engineering departments in institutes of higher education. It is based on lectures delivered at the Moscow Engineering Institute over a period of several years. Topics include interactions of elementary particles with a substance, ionization chambers, gas-discharge counters, crystal detectors, scintillation counters, and principles of error measurement theory. (TSS)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 32395, 32512, 32513, 32561, 32567, 32574, 32627, 32628, and 32727.

30847 (EUR-3910) THEORIE EINES DREIACHSEN- UND EINES FLUGZEIT-POLARISATIONSSPEKTROMETERS FUER THERMISCHE NEUTRONEN. (Theory for a Triaxial and Time-of-Flight Polarization Spectrometer for Thermal Neutrons).

Misenta, R. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Apr. 1968. 58p. (In German). Dep.

The problem of measuring the energy distribution after scattering of an initially monoenergetic and polarized beam separately for the two spin states is discussed. The theory of polarization spectrometers which allows these measurements is developed and applied to two proposed experimental arrangements: to a triple axis- and to a time-of-flight polarization spectrometer. The influence of an incomplete polarization of the impinging beam, the flipping probability of the spin flip device, and the quality of the analyser on the resolution by which the intensities of the two spin states can be separated are investigated. The separate measurements of the two intensities allow some new applications, e.g., in investigation of coherent and incoherent effects in the elastic and inelastic neutron scattering it is possible to separate completely the coherent and incoherent intensities. An estimate of the measuring times shows that the neutron flux of high flux reactors is sufficient for measurements with polarization spectrometers. (auth)

30848 (GAMD-8266) TOAD: A COMPUTER CODE FOR PROCESSING GAMMA-RAY SPECTRA. Drake, J.; Stewart, L. L.; Busch, D. D. (Gulf General Atomic, Inc., San Diego, Calif.). Apr. 3, 1968. Contract AT(04-3)-167. 85p. Dep. CFSTI.

TOAD is designed for use with the UNIVAC 1108 (64K) computer and is used primarily for processing data from the Gulf General Atomic 4096-channel TMC analyzer with magnetic tape readout. A description of subroutines, explanation of input variables, changes for processing certain binary tapes, computer and tape requirements, input forms, source program, and a sample problem are presented. (W.H.K.)

30849 (KFKI-7/1968) CORRELATION TYPE TIME-OF-FLIGHT SPECTROMETER WITH MAGNETICALLY CHOPPED POLARIZED NEUTRON BEAM. Pal, L.; Kroo, N.; Gordon, J.; Pellionisz, P.; Szlavik, F.; Vizi, I. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). Apr. 8, 1968. 18p. Dep.

The essential features of the correlation method of time-of-flight spectroscopy are discussed. An experimental setup including monocrystal slabs, the flipper chopper, the sample, and the neutron detector is described. Measurements were carried out in order to show the efficiency of the correlation method. (B.G.D.)

30850 APPLICATIONS OF HIGH-RESOLUTION Ge(Li) GAMMA SPECTROMETRY IN CRIMINALISTICS. Perkons, A. K. (Centre of Forensic Sciences, Toronto); Jervis, R. E. Trans. Amer. Nucl. Soc., 11: 82-3(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30851 DESIGN OF A SPLIT POLE MAGNETIC SPECTROGRAPH. Viswesvariah, M. N.; Sarma, N. (Bhabha Atomic Research Centre, Trombay, India). pp 582-6 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27-March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220-(Vol.2).

The focal properties and the detailed design of a proposed split-pole magnetic spectrograph are discussed. Details are given regarding the design of the support as well as the rotating mechanism of the magnet carrier. (auth)

30852 SIMPLE NEW DEVICE FOR A MOESSBAUER SPECTROMETER. Iyengar, P. K.; Parvathanathan, P. S. (Bhabha Atomic Research Centre, Trombay, India). pp 537-42 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27-March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220-(Vol.2).

The component of velocity of a particle performing uniform circular motion along chords parallel to a given diagonal varies linearly with the perpendicular distance from the center of rotation. A Moessbauer spectrometer based on this principle was constructed. The sample attached to a circular frame is rotated at constant speed, while the source and detector, coupled together and defining the direction of gamma ray detected along a chord of the circle, are uniformly displaced with respect to the center of rotation. Thus different Doppler shifts are introduced between the source and absorber depending only on the relative position from the center. This method has several advantages including simplicity, ease of automation and readily variable resolution. Typical spectra obtained by this method are presented. Several possible variations of this method are also discussed. (auth)

30853 USE OF SCINTILLATION GAMMA SPECTROMETER AS A CALIBRATION QUANTOMETER. Koptev, V. P.; Kruglov, S. P.; Suvorov, V. M.; Filimonov, E. A. (Inst. of Physics and Tech., Leningrad). Prib. Tekh. Eksp., No. 5, 130- (Sept.-Oct. 1967). (In Russian).

A gamma scintillation spectrometer was used as a quantometer for calibration of a bremsstrahlung beam with energies of 20, 30, 40, and 50 MeV. The calibration of 15, 17.5, and 20 cm lead absorbers with bremsstrahlung beam filtration equivalent to 5.35 g/cm^2 Al was carried out with ϕ 100 × 60 and 80 × 80 mm^2 NaI(Tl) scintillators. The calculations were based on bremsstrahlung spectra computed according to the Shiff's equation for bremsstrahlung photon emission at zero angle. The data obtained for the quantometer calibration were compared with the data obtained by other methods. (tr-auth)

30854 ELEKTRONNYYE TSIFROVYYE SPEKTROMETRY V EKSPERIMENTAL'NOY YADERNOY FIZIKE. (Electronic Digital Spectrometers in Experimental Nuclear Physics). Mel'nikov, G. P. Moscow, Atomizdat, 1966. 181p.

The book describes the main types, operating principles and areas of use of electronic digital spectrometers, that is the purely discrete digital sections of all possible electronic multichannel spectrometric devices such as amplitude analyzers, time selectors and the like. Attention is given most to digital spectrometers with 100-1,000 channels and with sufficiently flexible logic operations for the most typical laboratory research in experimental nuclear physics. The book is intended for engineers and physicists working in nuclear spectrometry, but may also be useful to teachers and students in engineering-physics. The book is considered to be the first book in the Russian language to give a description of the methods of classifying spectrometric devices and to give the correct terminology for several aspects of the subject where previously published terminology and classifications have been erroneous or indistinct. Topics include general problems of spectrometric techniques, classes and types of digital spectrometers for experimental nuclear physics, and fundamental operating modes of digital spectrometers in nuclear physics. (ATD)

High Energy Physics Instrumentation

Refer also to abstract 32039.

30855 (JINR-P13-3726) NEKOTORYE VOPROSY TEORII ROSTA I KONDENSATSII PUZYR'KOV V PUZYR'KOVYKH KAMERAKH. (Some Problems of the Theory of Bubble Growth and Condensation in Bubble Chambers). Tkachev, L. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1968. 17p. (In Russian). Dep.

The causes are analyzed of the divergence of theoretical and experimental values of the growth rate and that of condensation of bubbles in liquid hydrogen. It is shown that, while considering the heat transfer between a bubble and the liquid, one cannot consider the adjacent layer to be thin and the liquid heat capacity to be the constant independent of the temperature. Taking into account these factors the corrections appear, which can be compared with the value of the divergences observed. (auth)

30856 (MIT-2098-422, pp 10-12) ACCELERATOR PHYSICS COLLABORATION. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science).

Developments in the accelerator physics program at MIT are reported. Topics discussed include spark chambers for charge-exchange reactions from one to four GeV/c, the PEPR system for scanning and measuring photographs of bubble chamber tracks, construction of the 500-liter bubble chamber, and high-energy counter work at ANL. Publications are listed. (W.H.K.)

30857 (RHEL/R-157) MODULAR ELECTRONIC DATA ACQUISITION SYSTEM FOR MAGNETOSTRICTIVE READOUT OF WIRE SPARK CHAMBERS. Bairstow, R.; Cawthraw, M. J. (Rutherford High Energy Lab., Chilton (England)). Dec. 1967. 38p. Dep. UK 9s. 0d.

A data handling system for use with wire spark chamber experiments, using magnetostrictive readout, is described here. It is made deliberately modular in concept and design to cater for any number of chambers. The data are stored in 16 bit, 30 MHz scalers, mounted on standard printed circuit boards carrying four scalers with readout logic. These are gated off in sequence according to the magnetostrictive signal input by six stage shift register blocks, four to a printed circuit. A standard assembly of 128 timing channels has been designed capable of handling up to 36 inputs averaging three sparks each. Dual in-line digital integrated circuits have been used throughout. (auth)

30858 (UCID-2753) BUBBLE CHAMBER TRACK SIMULATION PROGRAM: SIMULATE. Johnson, Dave (California

Univ., Berkeley. Lawrence Radiation Lab.). Feb. 15, 1965. Contract W-7405-eng-48. 10p. Dep. CFSTI.

A computer program SIMULATE is described for simulating particle tracks for the Berkeley 72-inch bubble chamber. A track is simulated by numerically integrating an orbit with assumed energy loss, field variation, and Coulomb scattering; thus, the pseudo-film coordinates should simulate an idealized track with known errors. (W.H.K.)

30859 (UCID-2842) SPIRAL READER (MP-IIB) SYSTEM ELECTRONICS DESCRIPTION AND SPECIFICATIONS. Butler, Gerald V. (California Univ., Berkeley. Lawrence Radiation Lab.). Oct. 10, 1966. Contract W-7405-eng-48. 124p. Dep. CFSTI.

A description of the electronics system on the Spiral Reader (MP-IIIB) is given including descriptions of each sub-system with block diagrams and specifications. The general electronic conventions are discussed. A general knowledge of the principles of bubble chamber film measurement and of the PDP-4 computer is assumed. UCRL-16555 is recommended as prerequisite reading material. (auth)

30860 (UCID-2950) SCANNING TABLE MEASUREMENTS: BNL 80'' BUBBLE CHAMBER. Sprafka, Robert (California Univ., Berkeley. Lawrence Radiation Lab.). Nov. 30, 1966. Contract W-7405-eng-48. 11p. Dep. CFSTI.

The techniques and equations required for making measurements on the scanning table for the BNL 80 in. bubble chamber pictures taken with the Berkeley 46 mm camera are presented. (B.G.D.)

30861 INFLUENCE OF BACKGROUND CHARGE ON SPARK CHAMBER EFFICIENCY. Vovenko, A. S.; Vyrenkova, M. Ya.; Gladki, Ya.; Gus'kov, B. N.; Lyubimov, A. L.; Savin, I. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Prib. Tekh. Eksp., No. 6, 50-3(Nov.-Dec. 1967). (In Russian).

The efficiency of a multiplate spark chamber under conditions of a high charged-particle background was investigated. It was shown that the efficiency for recording the triggering particle decreases if the background particle passes through the spark chamber after the triggering particle but up to the moment of the high-voltage pulse in the chamber. The influence of the background particle on the efficiency of recording the triggering particle increases with the increase of the time interval between the passage of the triggering particle and the background particle. A possible explanation of this relation is given, and recommendations for increasing the efficiency of spark chambers in the presence of high background conditions are proposed. (tr-auth)

30862 METHODS FOR CALCULATING COULOMB SCATTERING AND BREMSSTRAHLUNG IN ANALYZING TRACKS FROM PROPANE BUBBLE CHAMBERS. Budagov, Yu. A.; Vinogradov, V. B.; Volod'ko, A. G.; Gerdyukov, L. N.; Dzheletsov, V. P.; Klimenko, S. V.; Novikov, V. G.; Patochka, I.; Flyagin, V. B.; Shlyapnikov, P. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Prib. Tekh. Eksp., No. 6, 5-19(Nov.-Dec. 1967). (In Russian).

Methods for determining kinematic parameters of tracks in bubble chambers were discussed, considering distortions introduced by Coulomb scattering and bremsstrahlung. The work of the program for uncorrected tracks on the computer in which Coulomb scattering is taken into account by the introduction of a Coulomb scattering matrix with minimizing functional and bremsstrahlung of electrons and positrons is taken into account by adjusting the tracks by means of an approximating curve with a variable radius of curvature is analyzed. The accuracy of the proposed methods for calculating Coulomb scattering and bremsstrahlung is tested by analyzing photographs from the 1 meter propane bubble chamber exposed to the 5-GeV/c meson (π^-) beam of the JINR synchrophasotron. (tr-auth)

30863 SPARK CHAMBER WITH INCREASED ISOTROPISM. Kozlov, M. I.; Rudenko, N. S. (Tomsk Polytechnic Inst., USSR). Prib. Tekh. Eksp., No. 6, 53-6(Nov.-Dec. 1967). (In Russian).

The results of investigations on the design of spark chambers with increased three-dimensional isotropism for recording charged particle tracks are presented. The increase in isotropism was achieved by the use of two pairs of high-voltage electrodes, the fields of which are mutually perpendicular. On each pair of electrodes is applied alternately two high-voltage pulses, which are shifted in time. The spark chamber records particle tracks in any direction except tracks where the angle is $\leq 45°$ to the axis of the chamber. (The chamber axis is parallel to its four electrodes.) (tr-auth)

30864 SYSTEM FOR PHOTOGRAPHY IN BUBBLE CHAMBERS WITH SMALL INSPECTION WINDOWS. Ermakov, K. N.; Komar, A. P.; Miroshkin, V. V.; Stabnikov, M. V. (Physical-Technical Inst., Leningrad). Prib. Tekh. Eksp., No. 6, 159-60(Nov.-Dec. 1967). (In Russian).

A new system for photographing particle tracks in bubble chambers with a variable scale of representation and a capability for photographing larger volumes is given. The system contains two objective lenses. The first, a short focus, is located at a small distance from the photographed volume and the second, long focus, completes the representation of the working volume on film. The use of such a system will simplify the design of bubble chambers since it eliminates the necessity of a cap for counterpressure and thick protective glasses. (tr-auth)

30865 ANALYTICAL FORMULAS FOR THE RANGE-ENERGY RELATIONS IN BUBBLE CHAMBERS. Krasznovszky, Sandor; Telbisz, Ferenc. KFKI (Kozp. Fiz. Kut. Intez.) Kozlem., 16: 99-104(1968). (In Hungarian).

Analytical formulae are given for the $R = f(T)$ and $T = f(R)$ functions for pion, kaon and proton. The constants have been evaluated for bubble chambers of various sizes, filled with different liquids: 1 and 2 m for hydrogen, 1 m for deuterium, 1 m for propane, and 0.5 m for xenon. (auth)

Radiation Dosimeters

Refer also to abstract 30825.

30866 (BNL-12452) SOURCES OF FISSION NEUTRONS AND THEIR DOSIMETRY. Fairchild, Ralph G. (Brookhaven National Lab., Upton, N. Y.). [1968]. 14p. (CONF-680420-2). Dep. CFSTI.

From Meeting of the Transplutonium Program Committee, Germantown, Md.

Sources of spontaneous fission neutrons are listed, and their possible therapeutic use is discussed. Dosimetry of a californium-252 fission neutron source in a tissue-equivalent phantom is described. (W.H.K.)

30867 (ORNL-TM-2145) INVESTIGATION OF THE OCD RADIOLOGICAL SURVEY METER CD V-715. De Lorenzo, J. T. (Oak Ridge National Lab., Tenn.). Mar. 12, 1968. Contract W-7405-eng-26. 26p. Dep. CFSTI.

Design of the battery-operated, portable monitoring CD V-715 instrument for measuring gamma dose rates in the range of 0.5 to 500 r/hr is presented. An ionization chamber is used. Discussed are long-term stability of voltage input sensitivity, leakage in input circuitry, battery drain, factors that influence calibration, circuit linearity and voltage sensitivity, and circuit check analysis. (W.H.K.)

30868 (UCRL-17751, pp 53-80) RADIOLOGICAL PHYSICS. (California Univ., Berkeley. Lawrence Radiation Lab.).

Exact measurements on the rate of energy transfer and its fluctuations were performed. Experimental approaches are being made to the problem of energy distribution of δ rays. For the purpose of solar-flare simulation, methods were developed for automated isodose surface measurements. For accurate area dose control in skin irradiation studies, a beam sweeper was designed and built at the 88-inch cyclotron. Collaborative studies were carried out with Nabuo Oda (Japan) on δ-ray studies; with Norman Baily, UCRL, on the use of proportional counters and tissue-equivalent chambers; and with the USNDRL San Francisco Laboratory on colorimetric dosimetry. Calculations carried out under the Omnitron study program on important beam parameters helped this program. (auth)

30869 RADIATION-SENSITIZED QUARTZ DOSIMETER. Muller, A. C.; Hill, F. B. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc., 11: 74-5(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30870 THERMOLUMINESCENCE IN RADIATION MEASUREMENTS. Suntharalingam, N. (Stein Research Center, Philadelphia). Trans. Amer. Nucl. Soc., 11: 68(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30871 PROTON RANGE AS A NEUTRON ENERGY INDICATOR IN THERMOLUMINESCENCE DOSIMETRY. Facey, Robert A. (Defence Chemical, Biological, and Radiation Establishment, Ottawa). Trans. Amer. Nucl. Soc., 11: 415-16(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30872 MEDICAL RADIATION DETECTING PROBE. (to National Aeronautics and Space Administration. British Patent 1,114,237. May 22, 1968. Priority date Dec. 23, 1965, United States.

The design of a silicon diode probe for in vivo radiation detection and dosimetry is presented. The probe is composed of a cylindrical silver casing with the bullet-shaped silicon detector protruding from one end. The two leads are designed coaxially to extend through the back of the cylindrical cable and connected to the electronic equipment. (W.H.K.)

30873 THE RELATIONSHIP BETWEEN EFFECTIVE-ENERGY AND RAD/R CONVERSION FACTORS IN HETEROGENEOUS PHOTON-ENERGY FIELDS. **Maillie, H. D.; Dutton, A. M.; Mermagen, H. (Univ. of Rochester, N. Y.). Health Phys., 14: 522-3(May 1968).**

The quantity effective energy is calculated from the half-value layer measured under a given set of beam conditions. It has been demonstrated that in practice there is a direct relation between the rad/R conversion factors for bone and muscle and the HVL of the photon field. It is questionable to assume, however, that a given effective photon energy would have the same conversion factor as an identical mono-energetic photon. In order to test this, HVL's were calculated in Al, Cu, and Pb, and from these the effective energies were also calculated. The spectral conversion factors for bone and muscle were also determined. A smooth relation was found between spectral conversion factors and effective energy. For all the spectra considered no difference was found between the calculated spectral conversion factors and the values for a mono-energetic beam of commensurate energy. (UK)

Radiometric Instruments

Refer also to abstract 30792.

30874 (RISO-M-637) DESCRIPTION OF THE SOFIE-III PROGRAMME NO. P-405. Oelgaard, P. L. (Danish Atomic Energy Commission, Risoe. Research Establishment). Aug. 1967. 52p. Dep.

The SOFIE-III program for investigations of the size of the Sphere of Importance around a neutron moisture probe, i.e., the size of the effective volume around the probe in which the moisture concentration is determined, is presented. The program is based on three-group diffusion theory. The geometrical arrangement is a point neutron source surrounded by two concentric zones the outer of which extends to infinity. The thermal neutron detector is either a point detector at the source or a line detector with its axis through the source, but situated outside the source. The inner zone is always a soil-moisture mixture, while the outer is either a soil-moisture mixture or vacuum. For a fixed composition of the outer zone (either vacuum or soil-moisture mixture) and a varying moisture content of the inner, the program calculates the radius of the inner zone for which the ratio between the neutron flux of the detector and the neutron flux of the detector if the inner zone extended to infinity, is equal to a given input value. (auth)

30875 NEUTRON DENSITOMETER FOR MEASURING VOID FRACTION IN STEAM-WATER FLOW. **Jackson, C. N. Jr.; Allemann, R. T.; Spear, W. G. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc., 11: 366-7(June 1968).**

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30876 INTERNATIONAL SOIL WATER SYMPOSIUM. VOLUME I. **Proceedings of the Czechoslovak National Committee of the International Commission on Irrigation and Drainage, Praha, June 6-12, 1967. Dvorak, Pavel (ed.). Praha, Czechoslovak Scientific-Technical Society for Water Management, 1967. 210p. (In English and French). (CONF-670648-(Vol.1)).**

Separate abstracts were prepared for four of the 16 papers presented. The other 12 papers were not in the scope of NSA. (W.H.K.)

For abstracts of individual papers see: 30877–30880.

30877 NEUTRON METHOD OF SOIL MOISTURE DETERMINATION. **De Boodt, M. pp 109-27 of International Soil Water Symposium. Vol. I. Dvorak, Pavel (ed.). Praha, Czechoslovak Scientific-Technical Society for Water Management, 1967.**

See CONF-670648-(Vol.1).

The development of neutron moisture gages for measuring water content of soils is discussed. Various neutron sources, moderators, and detector systems are briefly described, and main sources of errors are considered. (W.H.K.)

30878 UTILIZATION OF RADIOISOTOPES IN SOIL MELIORATION RESEARCH IN CZECHOSLOVAKIA. **Cabart, Jan (Research Inst. of Reclamation, Prague). pp 129-41 of International Soil Water Symposium. Vol. I. Dvorak, Pavel (ed.). Praha, Czechoslovak Scientific-Technical Society for Water Management, 1967.**

See CONF-670648-(Vol.1).

Radiometric moisture gages for determining the water content in soils are described. Gamma sources with G-M detectors, neutron sources with G-M detectors, and neutron sources with scintillation detectors are discussed. (W.H.K.)

30879 METHOD OF MEASUREMENTS OF SOIL MOISTURE BY NEUTRONIC MOISTURE METERS. **Emelyanov, V. A. pp 143-55 of International Soil Water Symposium. Vol. I. Dvorak, Pavel (ed.). Praha, Czechoslovak Scientific-Technical Society for Water Management, 1967.**

See CONF-670648-(Vol.1).

The neutron radiometric method for determining water content of soils is described. Factors affecting main parameters of the moisture meters are discussed including design of the system, hole and contact factors, and soil factors. Also correction of calibrating curves is considered. (W.H.K.)

30880 COMPARATIVE RADIOMETRIC INVESTIGATIONS OF THE HUMIDITY OF THE SOIL. **Ivanov, I.; Stanescu, E.; Ilieu, F.; Militaru, Al. pp 189-98 of International Soil Water Symposium. Vol. I. Dvorak, Pavel (ed.). Praha, Czechoslovak Scientific-Technical Society for Water Management, 1967.**

See CONF-670648-(Vol.1).

The results of comparative experiments for radiometric determination of the water content of soils are presented. Gamma and neutron sources and various detector systems were used. (W.H.K.)

30881 IMPROVEMENTS RELATING TO THE ANALYSIS OF SAMPLES OF MATERIAL. **Jones, Robert Earrol; Price, Harold James; (to Kaman Aircraft Corp.). British Patent 1,114,351. May 22, 1968. Filed Feb. 9, 1966.**

An activation analyzer composed of a radiation source, radiation detector system, and sample transfer system is described. The system is designed for neutron activation analysis of the oxygen content in beryllium samples on a mass production basis. (W.H.K.)

30882 EGGSHELL-STRENGTH DETERMINATION BY A BETA-BACKSCATTER TECHNIQUE. **Gerrard, Martha. Isotop. Radiat. Technol., 5: 284-6(Summer 1968).**

A nondestructive method was developed for determining eggshell strength by measuring the beta radiation backscattered from it. A 10 μCi ^{106}Ru–^{106}Rh source provides the beta radiation. (auth)

30883 PORTABLE RADIOISOTOPE X-RAY-FLUORESCENCE ANALYZER. **Gerrard, Martha. Isotop. Radiat. Technol., 5: 280-4(Summer 1968).**

A portable x-ray-fluorescence analyzer has been developed which consists of a 3-lb probe unit and a 12-lb electronics unit. In tests of the prototype unit, with radioactivity counting times of 10 to 100 sec, sensitivities of determination have ranged from 0.002% for silver in ores to 0.2% for sulfur in coal. (auth)

30884 RADIOTRACER PROPELLANT GAGE. **Gerrard, Martha. Isotop. Radiat. Technol., 5: 286-7(Summer 1968).**

A system for determining the amount of propellant remaining in the tank of a space vehicle, in a zero-gravity environment, is based on the principle of radiotracer dilution. A small amount of ^{85}Kr is injected, under pressure, into the tank ullage volume. As the propellant is consumed, the increase in ullage volume is accompanied by a decrease in the ^{85}Kr concentration, and the count rate of a sample of the gas is proportional to the volume of propellant remaining in the tank at any given time. (auth)

30885 AUTOMATIC CONTINUOUS MEASUREMENT OF THE CALORIFIC VALUE OF HEAVY OILS BY NEUTRONS. **Miyashita, Kyoichi (Mitsubishi Electric Mfg. Co., Tokyo). Genshiryoku Kogyo, 13: No. 10, 52-5(Oct. 1967). (In Japanese).**

A feasibility study was made of the "on-line" measurement of calorific values of heavy oils, running through a pipeline, by means of the neutron-moderation phenomenon. The experimental set-up consisted of the detector in a pipeline in the field, and the associated instruments indoors. The detector was a BF$_3$ counter, and the neutron source Ra-Be 10m Ci. As the result, it was found that by this method, heavy oil "C" could be measured automatically and continuously, with fair accuracy, and further the method could also be applied for heavy oils "A" and "B". The accuracies of measurement were even comparable with those by the bomb method. (NSA of Japan)

30886 NEW WELL LOGGING METHOD USING THE NEUTRON TUBE. **Itoh, Toshinobu (Japan Petroleum Development**

Co., Tokyo); Sekiguchi, Akira. Oyo Butsuri, 37: 322-33(Apr. 1968). (In Japanese).

Using a small neutron tube, a new method for oil-well logging has been developed on a laboratory scale. Because of a pulsed fast neutron (14 MeV, pulse width of about 100 μs., repetition rate 1 kHz.) which is injected into a formation, nuclear reaction takes place in the formation and two kinds of prompt gamma rays are emitted: one is the gamma ray resulting from inelastic scattering of neutrons and the other is from capture of neutrons. They are routed towards a gate which is synchronized with a neutron burst. 1) Both kinds of gamma rays are led to a pulse height analyzer. The discrimination between oil- and water-bearing sands is obtained by detecting the difference of counting rates on a gamma ray energy spectrum corresponding to carbon, oxygen and chlorine respectively. 2) Neutron-capture gamma rays are sent to a time analyzer simultaneously and the decay time constants of the thermal neutron in a formation are measured. This serves to reveal the kind of formation fluid and also the degree of porosity. The first is effective for indicating oil sands when the invasion of a mudfiltrate is shallow. The second seems to give the true decay time constant of thermal neutrons in a formation. (auth) (NSA of Japan)

30887 EGGSHELL STRENGTH TESTER (Engineering Materials). (Agricultural Research Service, Bettsville, Md. Agricultural Engineering Research Division. Oak Ridge National Lab., Tenn.). (CAPE-1730).
3 drawings.

A gage to measure eggshell strength is described which employs a nondestructive beta backscatter technique. The gage consists of a 10 μCi ^{106}Ru$-^{106}$Rh source, a Geiger–Mueller radiation detector, and a high voltage power supply. Beta particles from the source are directed to the egg. If the shell is thick or dense, β particles are reflected or back scattered to the detector. The amount of backscatter indicates eggshell strength. Eggshells are classified in 6 categories of shell strength ranging from very sturdy to fragile. (For details see TID-4100.) (F.S.)

Miscellaneous Instruments and Components

Refer also to abstracts 30756, 32012, 32017, 32573, 32934, 32965, and 33192.

30888 (EUR-3909) APPARATUS TO MEASURE THE THERMAL CONDUCTIVITY OF GRAPHITE NEAR ROOM TEMPERATURE. Van de Velde, J.; Ockfen, H.; Noels, T. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). 1968. 20p. Dep.

An apparatus for measuring the coefficient of thermal conductivity for irradiated or non-irradiated graphite specimens which has been set up in the LMA's graphite laboratory is described. The heat transfer principle is used for measuring the coefficient K near room temperature. The graphite specimen placed in a vacuum is held coaxially between the end faces of the two electrolytically pure copper probes which have the same cross-section as the sample, and of which, one is heated and the other is cooled. (auth)

30889 (JUL-507-PC) BAU EINES LOESCHGENERATORS FUER DEN BENDIX-MULTIPLIER M-105-G6 IM FLUGZEIT-MASSENSPEKTROMETER. (Construction of a Quench Generator for the Bendix Multiplier, M-105-G6, in the Time-of-Flight Mass Spectrometer). Petrick, W. H.; Pfeifer, J.-P.; Schindler, R. N. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Physikalische Chemie). Dec. 1967. 22p. (In German). Dep.

The quench generator for the BENDIX time-of-flight mass spectrometer is used to shield any portion of the mass spectrum by means of a 300 V pulse. The mechanical and electronic construction of the generator is described. The coupling of the generator to the mass spectrometer is discussed. Examples are given of the use of the generator. (J.S.R.)

30890 (ORNL-TM-1638(Pt.34)) NUCLEAR INSTRUMENT MODULE MAINTENANCE MANUAL. PART 34. MSRE TEST MODULE, ORNL MODEL Q-2634. Fray, E. N. (Oak Ridge National Lab., Tenn.). Mar. 21, 1968. Contract W-7405-eng-26. 17p. Dep. CFSTI.

The MSRE Test Module is a special purpose unit designed to supply calibration signals for testing the response of parts of the safety system of the Molten-Salt Reactor Experiment. It is packaged in a standard "two-unit" plug-in module of the ORNL Modular Reactor Instrumentation Series. The circuit, applications, acceptance procedures, and acceptance tests for the MSRE Test Module are described. (auth)

30891 (ORNL-TM-1638(Pt.35)) NUCLEAR INSTRUMENT MODULE MAINTENANCE MANUAL. PART 35. PERIOD SAFETY MODULE, ORNL MODEL Q-2635. Fray, E. N. (Oak Ridge National Lab., Tenn.). Mar. 15, 1968. Contract W-7405-eng-26. 15p. Dep. CFSTI.

The Period Safety Module is a current-sensing device which is connected in series with the input of a normal neutron flux-safety amplifier in a reactor safety system. Without disturbing the normal safety functions of the flux safety amplifier (Q-2602), the period safety module derives a signal which is proportional to the logarithm of reactor power (ionization chamber current) and takes the time derivative of the logarithmic signal to yield a signal proportional to inverse reactor period. The circuit is packaged in a standard "one-unit" plug-in module of the ORNL Modular Reactor Instrumentation Series. The circuit, applications, maintenance procedures, and acceptance tests for the Period Safety Module are described. (auth)

30892 (PRNC-26) RESEARCH IN PHOTOMULTIPLIER TUBE FATIGUE. A SIMPLE DEVICE FOR THE AUTOMATIC ELIMINATION OF FATIGUE EFFECTS IN PHOTOMULTIPLIER TUBES. Cantarell, I.; Almodovar, I.; Cuadrado, S. (Puerto Rico Nuclear Center, San Juan). Oct. 1963. Contract AT-(40-1)-1833. 23p. Dep. CFSTI.

Devices for the automatic elimination of fatigue effects influencing photomultiplier tube measurements are described. Either mechanical or electrical compensators can be used. The latter type consists of a logarithmic potentiometer and appears simpler in both construction and use. With the electrical compensator connected to a direct compensating circuit, and assisted by the mechanical inertia of the system, fatigue has been reduced to about 1% of the original value without compensation. This degree of compensation requires an appropriate ratio between the compensating potentiometer resistance and load resistance; no additional, more sophisticated components are necessary for precision spectrometry. An auxiliary standard source is necessary for measurements of short-lived nuclides. (auth)

30893 (TID-24501) LIQUID METAL VAPOR QUALITY METER. Final Report. Report No. 3540. Schwartz, H. W. (Bendix Corp., Southfield, Mich. Research Labs. Div.). Jan. 1968. Contract AT(04-3)-636. 61p. Dep. CFSTI.

The application of a flueric device to sense the quality of potassium vapor is described. The flueric device is a delay line oscillator; its frequency is a function of the quality of a wet vapor flowing through it. Quality is the ratio of the vapor mass to the total mass of the vapor-liquid mixture (the higher the ratio, the drier the mixture). The delay line oscillator is a bistable fluid amplifier with delay lines connecting the outputs back to the respective control ports of the amplifier. The operating principle of the oscillator was analyzed, and an oscillator was designed and built that would vary its output frequency as a function of the potassium quality. A frequency range between 900 and 980 hertz was established for quality ranging from 80 to 100 percent for potassium vapor at 1400°F. An expected frequency range between 1100 and 1180 Hertz, for the quality range from 80 to 100 percent, was indicated by test data using NaK-78. Thus, the resolution was 4 hertz for each one-percent change of quality. As the temperature increases, the output frequency decreases, but the resolution is still several hertz per one-percent change of quality. This delay line oscillator was fabricated from stainless steel by a diffusion-bonded construction and it was tested in an alkali metal test loop modified for these tests on potassium vapor. (auth)

30894 (UCRL-17773) PERFORMANCE OF A VALDRE HEATING AND TILTING STAGE IN THE SIEMENS ELECTRON MICROSCOPE. Sturcken, E. F. (California Univ., Berkeley. Lawrence Radiation Lab.). Apr. 1968. Contract W-7405-eng-48. 42p. Dep. CFSTI.

A Valdré type heating and tilting stage was constructed for the Siemens electron microscope. The design characteristics and performance of the stage are described. The stage was found to have rapid temperature response, smooth tilting capability and negligible drift of the area under observation at temperatures up to 1000°C. The performance of the hot stage was tested by employing it to observe the HCP to FCC transformation (417°C) of cold rolled cobalt and the temperature dependence of Bloch type magnetic domain walls in HCP cobalt. With the specimen at 450°C the transformation was complete in a few minutes. The HCP grains nucleated heterogeneously and, in seconds, grew to a grain size of about 0.5 μ. The transformation temperature was used to calibrate the specimen thermocouple. Domain walls along [0001] were observed to widen and became diffuse at 150°C and disappeared below 300°C as predicted from previous measurements of magnetization versus temperature versus crystallographic direction. These measurements have shown that the magnetocrystalline energy favors easy magnetization along [0001] from 0 to 250°C and easy magnetization along $(11\bar{2}0)$ and $(10\bar{1}0)$ above 250°C. An important limitation of high temperature microscopy appears to be the physical instability of foils in the <2000 Å thickness range. Even though devices and techniques can be developed to prevent bending and contamination, the high surface to volume ratio of the foils makes them inherently unstable. Cobalt has a low vapor pressure ($<10^{-10}$ atm) and high melting point (1495°C); however, foils of cobalt contracted, thickened, and formed numerous holes at 700°C. Procedures for installing the heating and tilting stage in the microscope are described in an appendix. (auth)

30895 (UCRL-18037) LASER INTERFEROMETER FOR MASS TRANSFER STUDIES. Beach, Kirk Watson (California Univ., Berkeley. Lawrence Radiation Lab.). Feb. 1968. Contract W-7405-eng-48. 51p. Dep. CFSTI.

Thesis.

A modified Mach-Zehnder Interferometer with a He–Ne laser light source has been constructed for the study of mass transfer in a rectangular duct electrochemical reactor with forced and free convection. The Cu/$CuSO_4$/Cu reactor can be operated in both laminar and turbulent flow regimes with fully developed flow. The interferometer is capable of measuring concentration differences in $CuSO_4$ of 10^{-4} molar with a resolution of 0.005 mm in the direction perpendicular to the electrode at a rate of 64 frames/sec and an exposure time of 1/1000 sec. A set of expressions has been derived for the calculation of the error due to light deflection. The error has been found to be considerable in cases where linear concentration profiles with large gradients exist in wide cells. (auth)

30896 (UNC-5215) A CONTINUOUS ELECTROCHEMICAL METER FOR MEASUREMENT OF HYDROGEN IN SODIUM. Progress Report, October 1, 1967–March 31, 1968. (United Nuclear Corp., Elmsford, N. Y. Research and Engineering Center). Apr. 30, 1968. Contract AT(30-1)-3908. 24p. Dep. CFSTI.

Development of an in-line electrochemical instrument for continuous measurement of hydrogen in sodium has begun. The sensor is a hydrogen concentration cell with an electrolyte containing hydride ions. A program plan for establishing the concept and developing a meter is described. Initial results of sensor studies in hydrogen and argon are reported. (auth)

30897 COMPUTER PROCESSING OF SAMPLING-OSCILLOSCOPE DATA. Cohn, Charles Erwin (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 72-3(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30898 NEW DEVELOPMENTS OF WPAFB IN COMPUTERIZED SPECTRAL ANALYSIS AND ISOTOPE IDENTIFICATION. Dooley, John A. (Wright Patterson Airforce Base, Ohio); Young, Myron; Gorrell, James H.; Polishuk, Paul; Singhal, Narayan; Thompson, James M. Trans. Amer. Nucl. Soc., 11: 73-4(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30899 ULTRASONIC FUEL-ELEMENT COOLANT CHANNEL-THICKNESS PROFILE PLOTTING SYSTEM. Arave, A. E. (Phillips Petroleum Co., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc., 11: 134-5(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30900 DYNAMIC CHARACTERISTICS OF A SODIUM OXIDE PLUGGING INDICATOR. McPheeters, Charles C.; Biery, John C. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc., 11: 115-16(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30901 DECUS PROCEEDINGS, FALL 1965. Papers and Presentations, Fall Symposium, November 29, 1965, Stanford, California. Maynard, Mass., Digital Equipment Computer Users Society, 1966. 94p. (CONF-651130).

One of the 14 papers presented was abstracted. Two of the papers were previously included in NSA as 20: 11401 and 20: 14861. The remaining 11 papers were not sufficiently within the scope of NSA. (W.H.K.)

For an abstract of the individual paper see: 30902.

30902 ON-LINE REDUCTION OF NUCLEAR PHYSICS DATA WITH THE PDP-7. Bevington, Philip R. (Stanford Univ., Calif.). pp 33-9 of DECUS Proceedings, Fall 1965. Maynard, Mass., Digital Equipment Computer Users Society, 1966.

See CONF-651130.

In the continuing debate over the relative merits of fixed-wire analyzers vs. computer systems for the acquisition of nuclear physics data, the PDP-7 has emerged as an excellent compromise between cost and capability. The advantages inherent in a computer system are illustrated with specific ways in which the Stanford Computer for the Analysis of Nuclear Structure (SCANS) is used to reduce, point-by-point, on-line data from nuclear physics experiments, as well as to analyze such data with real-time control. Specifically, programs to identify and sort charged particles with thick (E) and thin (dE/dx) solid state detectors, to stabilize the scale of pulse-height spectra, and to control the acquisition of two-parameter data are discussed. The dead time contributed by these programs is shown to be negligible. The equally important ability to control the subsequent analysis of these data in real-time is also discussed with reference to the methods adopted by SCANS to accept, record, and display the data. (auth)

30903 APPLICATIONS OF A COMPUTER-CONTROLLED NEUTRON ACTIVATION ANALYSIS SYSTEM. Churchill, T. R. (Atomic Energy of Canada Ltd., Ottawa). Trans. Amer. Nucl. Soc., 11: 94-5(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30904 INSTRUMENT FOR MEASURING MECHANICAL VIBRATIONS IN FAST-PULSE REACTOR CORES. Ellis, James F. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 342(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30905 OPERATING EXPERIENCE WITH A MINIATURIZED NEUTRON FLUX SENSOR. Kinzer, J. E.; Park, T. A.; Chandler, E. M. (Atomics International, Canoga Park, Calif.). Trans. Amer. Nucl. Soc., 11: 336-7(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30906 OPERATING EXPERIENCE WITH A MINIATURIZED PRESSURE SENSOR. Kinzer, J. E.; Babbe, E. L. (Atomics International, Canoga Park, Calif.). Trans. Amer. Nucl. Soc., 11: 337-8(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30907 STUDIES OF A LOW-VOLTAGE ARC LASER. Herceg, J. E.; Miley, G. H. (Univ. of Illinois, Urbana). Trans. Amer. Nucl. Soc., 11: 16-17(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30908 IMPROVEMENTS IN OR RELATING TO HIGH-VOLTAGE PULSE-GENERATING TRANSFORMERS AND CIRCUITS FOR USE THEREWITH. Martin, John Christopher; Smith, Ian Douglas (to United Kingdom Atomic Energy Authority). British Patent 1,114,713. May 22, 1968. Filed Dec. 9, 1964.

The design of a pulse transformer for generating high voltage pulses for operating flash x-ray tubes is presented. It is composed of a winding formed with a conducting foil and an insulating sheet wound into a roll with output connections from the two ends of the winding. The foil and sheet are immersed in a dielectric liquid which contains an additive to make it slightly electrically conductive to reduce electric field gradients at the edges of the foil. (W.H.K.)

30909 ION STORAGE IN THREE-DIMENSIONAL, ROTATIONALLY SYMMETRIC, QUADRUPOLE FIELDS. I. THEORETICAL TREATMENT. Dawson, P. H.; Whetten, N. R. (General Electric Research and Development Center, Schenectady, N. Y.). J. Vac. Sci. Technol., 5: 1-10(Jan.-Feb. 1968).

The theoretical basis for the trapping of charged particles in a three-dimensional, rotationally symmetric, quadrupole field is discussed. A sensitive mass spectrometer and an ion gage based on ion storage have been constructed. Background material for this work is presented, based on numerically computed solutions to the differential equations of motion. Predictions are obtained concerning ion trajectories, resolution, sensitivity, storage, and peak shape. (auth)

30910 IMPROVEMENTS IN CURRENT CONTROL. (to General Electric Co.). British Patent 1,112,606. May 8, 1968. Priority date Aug. 14, 1964, United States.

Solid state circuitry for controlling the beam current of an electron gun for an x-ray tube having an emitting electrode and accelerating electrodes is presented. A feedback circuit is designed for the beam current sensing system to regulate the pulsing frequency of the emitting electrode. (W.H.K.)

30911 ANNUNCIATOR CIRCUIT. (to U. S. Atomic Energy Commission). British Patent 1,112,468. May 8, 1968. Priority date Oct. 1, 1965, United States.

An annunciator circuit for generating an audio alarm in response to an event represented by an electrical pulse is presented. A capacitor is discharged through a loudspeaker when a silicon controlled rectifier is triggered. (W.H.K.)

30912 ION STORAGE IN THREE-DIMENSIONAL, ROTATIONALLY SYMMETRIC, QUADRUPOLE FIELDS. II. A SENSITIVE MASS SPECTROMETER. Dawson, P. H.; Whetten, N. R. (General Electric Research and Development Center, Schenectady, N. Y.). J. Vac. Sci. Technol., 5: 11-18(Jan.-Feb. 1968).

A mass spectrometer has been constructed in which ions are trapped in a three-dimensional, rotationally symmetric, quadrupole field. Ions of a specific charge to mass ratio are stored and then periodically drawn out of the trapping field into an electron multiplier. The ion trapping feature permits integration of the ion current over long periods of time. Electrodynamic ion trapping also enables a long effective path length to be attained in a small size device. Ions have been stored for several days using a low-resolution mode. Experimental data are presented concerning storage time, resolution, and sensitivity. Factors affecting the peak shape include storage time, resolution, and bias voltage between the end-caps. (auth)

30913 TWO-CASCADE ENERGY-MASS ANALYZER. Sysoev, A. A.; Nikolaev, B. I.; Chebaevskii, B. F.; Samsonov, G. A. At. Energ. (USSR), 24: 261-2(Mar. 1968). (In Russian).

An energy-mass analyzer is described with a high mass resolution due to compensation of aberrations which limited the previously attainable resolution. A modulator M forms an ion "packet." The ions emerging from the modulator at different angles are separated according to energies in an electrostatic focusing system. After passage through a slit the ions pass through another electrostatic focusing system and another slit to a detector. Because of a proper choice of geometrical parameters and distribution of fields, the aberrations with respect to the original angle of selection α can be reduced to a very small value. Thus ion beams with large angles of divergence can be selected without decreasing the mass resolution. The energy resolution was found to be about 200 experimentally. The mass resolution increased with increasing ion mass. Neighboring xenon isotopes ^{131}Xe and ^{132}Xe are resolved at the level of 50%. (TTT)

30914 COINCIDENCE-ANTICOINCIDENCE CIRCUIT ON TWO-DIODE TUNNEL. Sanin, A. A.; Shareiko, P. N. (Moscow Inst. of Physics). Prib. Tekh. Eksp., No. 6, 70-6(Nov.-Dec. 1967). (In Russian).

A coincidence-anticoincidence circuit with two tunnel diodes is described. The resolving coincidence time is 2.5 to 3 n sec and anticoincidence is 4.5 to 6.8 n sec. The sensitivity of the controlling element for coincidence selection is 40 to 80 mV. (tr-auth)

30915 COMPENSATION METHOD FOR INCREASING THE ACCURACY OF TIME INTERVAL MEASUREMENTS. Maisyukov, V. D.; Fedorchenko, S. N. Prib. Tekh. Eksp., No. 6, 64-70 (Nov.-Dec. 1967). (In Russian).

An analysis was conducted of the errors produced by amplitude variations in input signals of time-to-amplitude converters. A compensation method for error reduction based on algebraic addition of output signals and functional signal amplifiers at the beginning and end of measurement was examined. An estimate of amplitude characteristics of functional amplifiers was given for the case of ideal compensation and the effect of these characteristics on the accuracy of the time measurements for the case of optimum piecewise-linear approximation. The results of the estimate are compared with experiment for the simplest case of approximation. (tr-auth)

30916 CRITERION OF THE FEU AMPLIFICATION COEFFICIENT STABILITY IN SPECTROMETRIC PERFORMANCE. Pertsev, A. N.; Tolkach, P. N. (Belorussian State Univ., Minsk). Prib. Tekh. Eksp., No. 6, 142-4(Nov.-Dec. 1967). (In Russian).

A criterion of stability of the FEU amplification factor during spectrometric operation was obtained on the basis of the thermal dynode balance and its semiconducting properties. (tr-auth)

30917 MEASUREMENTS OF THE TIME-OF-FLIGHT STRAGGLING IN FEU-30 WITH TIME-DEPENDENT OPERATION. Kulinich, Yu. A.; Rukavishnikov, V. G. Prib. Tekh. Eksp., No. 6, 140-2(Nov.-Dec. 1967). (In Russian).

The time-of-flight of the photoelectron in a FEU-30 photomultiplier was measured as a function of the position of the light spot on the photocathode. In the case in which the azimuthal time straggling for the first diode in the active part of 40 mm photocathode reached 0.3 nsec the total time straggling in the FEU does not exceed 0.4 nsec. (tr-auth)

30918 NUCLEAR MAGNETOMETER WITH FLOWING WATER. Yudin, V. A. (Moscow Inst. of Problems in Physics). Prib. Tekh. Eksp., No. 6, 188-90(Nov.-Dec. 1967). (In Russian).

The design and performance of a nuclear magnetometer based on magnetic resonance in water flowing through a measured field are described. Preliminary magnetization of water and production of nuclear magnetic resonance signals are obtained in the field of the same constant magnet The range of the magnetic fields varies from 0.5 to 10,000 Oe, with the relative accuracy 5×10^{-4} to 5×10^{-5}, respectively. (tr-auth)

30919 CHARGE SENSITIVE PREAMPLIFIER (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1734). 2 drawings.

A wide-band low-noise charge sensitive preamplifier is described. The preamplifier has a noise line-width significantly lower than that of the best vacuum-tube preamplifier, and a high gain-band width product which allows stabilization against detector capacitance fluctuations over a wide range of pulse-shaping time constants. The open-loop gain of both the input charge-sensitive section and the output cable driver section is sufficiently stabilized against temperature fluctuations to allow the feedback capacitor to control the gain drift of the entire preamplifier. (For details see TID-4100.) (F.S.)

30920 STUDY OF THE METHOD OF SEPARATION OF ISOTOPES USING TIME-OF-FLIGHT PRINCIPLE. Ramana, J. V.; Navalkar, M. P. (Bhabha Atomic Research Centre, Trombay, India). pp 543-7 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27-March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.
See CONF-670220-(Vol.2).

Ions emitted from a thermal ion source are accelerated and bunched by electrostatic fields. The bunches of ions of different mass travel with different velocities and become separated along the flight tube. The desired mass is selected by electronic means and the output measured on a dc amplifier. Preliminary experiments have been done with rubidium, cesium, and thallium. Ion currents of the order of 10^{-10} amperes have been obtained. The resolution is about 1 mass unit and mass scale calibration is linear in the mass range 85 to 205. The instrument is designed for a transmission of about 25%. (auth)

30921 MOESSBAUER EFFECT ANALYZER. Ando, Eiichi; Fujio, Yasuo (Shimadzu Seisakusho Ltd., Japan). Oyo Butsuri, 37: 307-13(Apr. 1968). (In Japanese).

An automatic controlled Mössbauer Effect Analyzer using a specially designed electromechanical transducer is described. Input voltage is integrated by an operational amplifier and its output is fed to the driving coil of the transducer. Negative feedback is applied to get stable action of the transducer. Our prototype apparatus can be selected either a saw tooth or a parabolic mode according to the object of the experiment. The reliability of this analyzer was ±0.3% and an attainable maximum velocity was ±50mm/s. (auth) (NSA of Japan)

30922 MNOGOKANAL'NYYE ANALIZATORY YADERNOY FIZIKI. (Multichannel Analyzers in Nuclear Physics). Matalin, Lev Aleksandrovich; Chubarov, Sergei Ivanovich; Ivanov, Anatolii Alekseevich. Moscow, Atomizdat, 1967. 357p.

Changes in methods of multichannel analyzer design and construction which have taken place primarily as a result of the introduction of semiconductor elements and digital computers are covered. In particular, material presented at domestic and international conferences dealing with the utilization of multiparameter analyzers in nuclear physics and with instrumentation techniques in nuclear pulse analyzers is included. (ATD)

30923 DUAL-BLOWER-MOTOR CONTROL (Engineering Materials). (California Univ., Livermore. Lawrence Radiation Lab.). (CAPE-1729). 7 drawings.

A control circuit used for dual motors, one running and one on standby is described. If one motor fails, the other takes over. The control is used on manifolds for glove boxes handling high radioactivity where it is necessary to maintain negative pressure. (For details see TID-4100.) (F.S.)

30924 RANDOM PULSE GENERATOR (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1733). 1 drawing).

A random pulse generator is described which is used in testing nuclear instruments. The radioactive source usually used is replaced by a noisy avalanche diode which supplies pulses which are random in time, but have a fixed amplitude, and whose mean rate is stable yet can be easily adjusted. The output rate is determined by the number of amplified noise pulses exceeding a discriminator threshold, and the mean role is stabilized by observing the output with a rate meter and controlling the avalanche diode standing current. Time distribution closely matches the theoretical Poisson distribution. Output mean rates from 100 Hz to 10 kHz may be selected. Mean rate stability exceeds most measurement requirements. A typical use is to sample a linear voltage ramp; random samples provide a differential linearity check for a pulse-height analyzer. The unit is constructed in a 5¼ in. high single-width NIM. (For details see TID-4100.) (F.S.)

Radiation Effects on Instruments and Instrument Components

30925 RADIATION HARDENED NERVA PRESSURE TRANSDUCER. Della Villa, L. A. (Aerojet-General Corp., Sacramento, Calif.). Trans. Amer. Nucl. Soc., 11: 26(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30926 NUCLEAR RADIATION EFFECTS IN SEMICONDUCTOR AND TEMPERATURE MEASURING DEVICES. Verma, J. K. D.; Nag, B. D. (Saha Inst. of Nuclear Physics, Calcutta). pp 4.6.1-6 of Thermometry. New Delhi, National Physical Laboratory, [1966].

The phenomenon of radiation damage in some semiconductor and electric devices was reviewed. The effect of nuclear radiation environment on temperature measuring devices such as thermocouples, resistance thermometers and thermistors was discussed. (auth)

30927 RADIATION EFFECTS AND ELECTRICAL STABILITY OF METAL/NITRIDE/OXIDE/SILICON STRUCTURES. Perkins, C. W. (Hughes Aircraft Co., Fullerton, Calif.); Aubuchon, K. G.; Dill, H. G. Contract NOnr-4837(00). Appl. Phys. Lett., 12: 385-7(June 1, 1968).

Radiation-induced threshold voltage shifts in MNOS structures are measured as a function of oxide layer thickness. The shifts for negative biases vanish at an oxide thickness near 125 Å and remain negligible for positive biases at this thickness. Electrical stability for this thickness is maintained for gate voltages from −40 to +35 V. (auth)

LIFE SCIENCES

Biochemistry, Physiology, and Molecular Biology

Refer also to abstracts 30469, 31017, 31024, 31033, 31043, 31048, 31055, 31070, 31143, 31154, 31170, 31202, 31206, 31211, 31217, 31229, 31248, 31264, 31267, 31281, 31288, 31291, and 31985.

30928 (ACRH-1000-42) TOXIC EFFECTS OF LITHOCHOLIC ACID AND RELATED 5β-H STEROIDS. Palmer, Robert H. (Chicago Univ., Ill. Dept. of Medicine. Argonne Cancer Research Hospital, Chicago, Ill.). Sept. 1967. Contract AT(11-1)-69. 15p. (CONF-670961-1). Dep. CFSTI.

From Conference on Bile Salt Metabolism, Cincinnati, Ohio.

The extensive biological toxicity of lithocholate and related steroids is described. Lithocholate and its taurine and glycine conjugates are the most potent steroids known in their ability to disrupt cells and cellular membranes. Lithocholate and glycolithocholate are unique among bile acids in possessing both the structural requirements for pyrogenicity and the capacity to induce bile duct proliferation. Lithocholate and its derivatives are also the only bile acids known to undergo physiological sulfate conjugation, but it is not yet known whether this results in detoxification. Further studies on the metabolism and pharmacological activity of lithocholate and its derivatives may clarify their significance in health and disease. (auth)

30929 (BMwF-FBK-67-84) LIPOIDVERAENDERUNGEN IN VERSCHIEDENEN RATTENORGANEN NACH GANZKOERPERBESTRAHLUNG MIT LETALEN ROENTGENDOSEN. (Lipid Alterations in Several Rat Tissues After Whole Body Irradiation With a Lethal X-Ray Dose). Eberhagen, D.; Zoellner, N. (Munich Univ. (West Germany). Medizinische Poliklinik). Oct. 1967. 67p. (In German). Dep.

Rats were submitted to total body irradiation with 1500 R. At different times after the irradiation several lipid parameters were studied in blood serum, liver, adrenal, kidney, spleen, and heart muscle. Of special interest was the behavior of the radiosensitive polyunsaturated fatty acids, that are converted to toxic lipoperoxides by the action of the radiation. (auth)

30930 (COO-690-29) RADIATION EFFECTS IN BIOCHEMISTRY AND ORGANIC CHEMISTRY. Technical Progress Report, October 15, 1966–October 14, 1967. Tolbert, Bert M. (Colorado Univ., Boulder). Contract AT(11-1)-690. 73p. Dep. CFSTI.

Progress is reported on the following radiation studies: effects on aspartate transcarbamylase; effects on exchangeable hydrogens of lysozyme; conformational damage in irradiated lysozyme; activation energy and comparative loss of hydrogens at low temperatures; role of free radicals in radiation chemistry of proteins; role of free radicals in denaturation of lysozyme; theory of conformation changes induced by ionizing radiation; and gamma irradiation of lactic acid dehydrogenase. (H.L.W.)

30931 (NYO-1822-21) CALCIUM AND STRONTIUM METABOLISM. I. GROSS ACCUMULATION OF CALCIUM AND STRONTIUM BY TETRAHYMENA. Ballentine, Robert; Burford, Dorothy D. (Johns Hopkins Univ., Baltimore, Md. McCollum–Pratt Inst.). Dec. 15, 1966. Contract AT(30-1)-1822. 45p. Dep. CFSTI.

A metabolic concentration sink system is postulated as one possible mechanism to account for the uptake and accumulation of many di- and polyvalent elements. In Tetrahymena it is shown that there is an active accumulation of calcium and strontium that is restricted to growing cultures; it does not occur in resting cell suspensions. This accumulation favors calcium as compared to strontium, a discrimination factor between the two elements having a value ranging from 1.64 to 4.70 depending upon the nutritional and cultural status of the organism. This factor also varies both with the absolute calcium concentration and with the calcium : strontium ratio. By the development of suitable culture techniques, together with a method of freeing complex media from contaminating trace metals, it was possible to make reproducible measurements of the accumulation of calcium and strontium during the growth of Tetrahymena populations. Using the generation number as an index of physiological age the rate of protein synthesis per cell was found to increase slightly in young cultures, but to decrease in aging populations. Strontium accumulation was relatively constant throughout the culture life, while calcium showed a continuous slight decrease during this period. On the basis of a number of differences observed between calcium and strontium relative to accumulation, their behavior in resting cell populations, and their competition for the accumulative mechanisms, it was suggested that calcium and strontium each have certain portions of their metabolic pathways that are independent of each other in spite of their great chemical similarity. (auth)

30932 (NYO-1822-24) CALCIUM AND STRONTIUM METABOLISM. IV. NUTRITIONAL CORRELATIVES OF CALCIUM AND STRONTIUM ACCUMULATION. Burford, Dorothy D.; Ballentine, Robert (Johns Hopkins Univ., Baltimore, Md. McCollum–Pratt Inst.). Dec. 15, 1966. Contract AT(30-1)-1822. 19p. Dep. CFSTI.

Earlier studies showed that in Tetrahymena pyriformis not only is the uptake of calcium and strontium dependent upon metabolism associated with growth, but also the pattern of metabolism of these elements is responsive to physiological culture conditions. One way in which the physiological state of a culture can be modified so as to yield information concerning the nature of the metabolism of calcium and strontium is to provide the growing organisms with quantities of essential nutrients which are sub-optimal for growth. When Tetrahymena were grown in a chemically defined medium and subjected to various growth factor deficiencies, each deficiency being examined one at a time, it was found that the normal pattern of calcium and strontium metabolism was not altered by deficiencies of pyridoxamine, thiamine, pantothenate and folic acid. Conversely, the pattern was decidedly altered by reduction to a sub-optimal level of either riboflavin or nicotinamide. The effect of these latter deficiencies was qualitative rather than merely quantitative in nature; nicotinamide deficiency led to an increase in the amount of calcium accumulated during growth and a simultaneous decrease in the amount of strontium taken up. Both nicotinamide and riboflavin are moieties of electron transport coenzymes, thus suggesting that electron transport high-energy intermediates may be important in the metabolism of these elements in the intact cell, as they are in the in vitro accumulation of calcium by isolated mitochondria. (auth)

30933 (PRNC-12) RESONANCE IN RADIATION EFFECTS. I. RESONANCE RADIATION EFFECTS OF LOW ENERGY MONOCHROMATIC X-RAYS ON CATALASE. II. CHARACTERIZATION OF A MONOCHROMATIC HIGH INTENSITY VARIABLE WAVELENGTH X-RAY SOURCE IN THE 5 TO 20 keV REGION. Progress Report No. 1. Gomberg, Henry J.; Luse, Robert A.; Vazquez Martinez, Florencio (Puerto Rico Nuclear Center, Mayaguez). Jan. 1963. Contract AT(40-1)-1833. 79p. Dep. CFSTI.

Experiments using monochromatic x radiation in the energy range 6.4 to 8.3 keV showed an increased inactivation of the metalloenzyme catalase at or near the K-absorption edge of iron (7.11 keV). This was taken to confirm the resonance radiation hypothesis of Gomberg and previous experimental work of Emmons and Paraskevoudakis. X radiation intensities of 2×10^{11} photons per hour were measured in a sample holder of the Fricke ferrous ammonium sulfate dosimeter. A more sensitive method for detection of the ferric ion produced was developed using ferric-thiocyanate complex. (auth)

30934 (RT/PROT-(67)15) MATHEMATICAL EXPRESSION TO FACILITATE THE CALCULATION OF SYSTEMATIC RETENTION AND URINARY EXCRETION RATE IN CASE OF INTERNAL CONTAMINATION DUE TO INHALATION OF "SLOWLY SOLUBLE" COMPOUNDS OF RADIOACTIVE ELEMENTS. Breuer, F. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1967. 25p. Dep.

The body retention and excretion functions of time following an instantaneous uptake of radioelements are represented either by exponential functions, or by sums of exponential functions, or by power functions, or by sums of exponentials plus power functions. In the case of instantaneous intake by inhalation of slowly soluble materials, these are transferred from the lungs to the body with a function of time corresponding to a sum of exponential functions. To solve the problem of the calculation of body retention and excretion following an inhalation of slowly soluble materials, the convolutions of exponential functions with exponential functions or convolutions of exponential functions with power functions were used. A mathematical expression is calculated to solve convolutions of exponential functions with power functions. Tables and plots of this expression are reported. Appendix contains an example of the calculation for ^{235}U. (auth)

30935 (SZS–16/67) DIE INHALATION VON RADIOAKTIVEN SUBSTANZEN. LITERATURUEBERSICHT. TEIL II. (The Inhalation of Radioactive Substances. Literature Survey. Part II). Gensicke, F.; Nitschke, H.-W. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). Nov. 1967. 20p. (In German). Dep.

The metabolism of inhaled particles containing radioisotopes of Pu, Np, Am, and Cm is surveyed, and 114 references are presented. (C.H.)

30936 (UCRL–50405) EXCRETION RATES OF THE GROUP IA ELEMENTS IN BEAGLES. Chertok, Robert J.; Lake, Suzanne (California Univ., Livermore. Lawrence Radiation Lab.). Apr. 2, 1968. 11p. Dep. CFSTI.

The normal rates of excretion of the Group IA elements were determined in 8 spayed female beagles by atomic absorption spectroscopy of 24-hr urine samples and periodic serum samples over a period of 16 days. The average excretion rates per day were 1.84 μM for Li^+, 35.27 mM for Na^+, 24.14 mM for K^+, 23.12 μM for Rb^+, and <7.5 μM for Cs^+. The same 8 beagles were then used in four successive experiments to determine the excretion rates of the five elements after the intravenous injection of LiCl, RbCl, or CsCl (10 μM per kg body weight), or a mixture of the three (10 μM of each per kg body weight). After the injection of LiCl, Li^+ was excreted rapidly with a triphasic curve; the excretion rates of Rb^+, K^+, Na^+, and Cs^+ were unaffected. After the injection of RbCl, the excretion of Rb^+ was elevated for 12 days; the excretion of K^+ was also slightly elevated, but those of Li^+, Na^+, and Cs^+ were unaffected. Injected CsCl was excreted slowly with a triphasic curve, but the other four rates were unchanged. Li^+, Rb^+, and Cs^+ injected together produced approximately the same results as when injected alone, except that the effect of Rb^+ on the excretion of K^+ was less marked. (auth)

30937 (UCRL–17751, pp 1-26) MOLECULAR STUDIES. (California Univ., Berkeley. Lawrence Radiation Lab.).

WATER—radiolysis of, by electron spin resonance determination of
LINEAR ACCELERATORS—development for establishment of pulse radiolysis facilities
TRYPSIN—radioinduced free radicals in, electron
NUCLEIC ACID—radiation effects on, in relation to excited electronic states
BIOLOGICAL SYSTEMS—determination of effects of homogeneous magnetic fields on

30938 (UCRL–17751, pp 27-40) CELLULAR STUDIES. (California Univ., Berkeley. Lawrence Radiation Lab.).

NUCLEI—effects on cell systems
LINEAR ENERGY TRANSFER—effects on radiosensitivity of stem cells in mice as measured by spleen colony-forming technique
X RADIATION—effects on cultured mammalian cells, combined effects of ultrasonic waves on
CHARGED PARTICLES—effects on stem cells of mice, effects of LET on

30939 A NEW VALUE FOR THE LONG COMPONENT OF THE EFFECTIVE HALF-RETENTION TIME OF ^{203}Hg IN THE HUMAN. Johnson, J. E.; Johnson, J. A. (Colorado State Univ., Fort Collins). Health Phys., 14: 265-6(Mar. 1968).

In the course of routine whole-body counting of some students one subject was found to have an appreciable body burden of ^{203}Hg. This was explained as due to a previous therapeutic dose of ^{203}Hg-neohydrin. The effective half-retention time (T_{eff}) was found to be 30 days, and the calculated biological half-retention time (T_B) was 84.2 days. The ICRP published value for T_{eff} for ^{203}Hg in the whole body is 8.2 days and for T_B is 10 days. A two-component retention function of ^{203}Hg-neohydrin in humans has been found; of the administered dose 75% was eliminated with T_{eff} 5.25 hr and 25% with T_{eff} 7 days. It is concluded that it would seem reasonable to revise the ICRP value of T_{eff} for purposes of dose calculation and retention of ^{203}Hg. (UK)

30940 IN VITRO UPTAKE OF ^{75}Se BY RED BLOOD CELLS FROM THE IMMATURE OVINE DURING VARYING SELENIUM INTAKES. Lopez, Perla L.; Preston, R. L.; Pfander, W. H. (Univ. of Missouri, Columbia). J. Nutr., 94: 219-26(Feb. 1968).

Six crossbred wether lambs were used to study the effect of varying Se intake upon uptake of ^{75}Se in vitro by ovine red blood cells. In a second experiment, 16 crossbred wether lambs were equally allotted among four dietary Se levels of 0.014, 0.264, 0.514, and 5.014 ppM. The feeding trial lasted 104 and 107 days for experiments one and two, respectively. Lambs receiving 0.264 and 0.514 ppM Se gained faster, consumed more feed, and had a higher feed efficiency than lambs in other dietary groups. Lambs on 0.014 ppM Se performed better than with the 5.014 ppM level. Adequate vitamin E may have prevented deficiency syndromes in lambs fed the low level of Se. Two lambs on the 5.014 ppM level exhibited symptoms of chronic selenosis. The uptake of ^{75}Se was significantly correlated with incubation time in the presence of an O_2-CO_2 mixture. The initial influx and rate of in vitro uptake of ^{75}Se by ovine blood cells decreased with increasing Se level in the diet. The in vitro uptake of ^{75}Se by red blood cells proved to be useful to assess the nutritional Se status in the immature ovine. (BBB)

30941 HEALTH HAZARDS FROM ^{65}Zn POLLUTION. Strain, William H.; Pories, Walter J.; Zaresky, Stephen A.; Dattilo, Elaine (Univ. of Rochester, N. Y.). Trans. Amer. Nucl. Soc., 11: 60-1(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

30942 THE WAVELENGTH DEPENDENCE OF SOME EFFECTS OF ULTRAVIOLET RADIATION ON IN VITRO DNA OF PHAGE α. Cremonese, M. (Istituto Superiore di Sanita, Rome). Biophys. J., 8: 153-63(Feb. 1968).

The mechanism of radioinduced changes in the DNA molecule was examined on the basis of the wavelength dependence of some of the effects of uv radiation on the physicochemical properties of DNA of phage irradiated in vitro. Analytical ultracentrifugation and spectrophotometry, were used to study the breaking of individual polynucleotide strands, local denaturation, presence of a fraction of molecules resistant to denaturation, and increase in the buoyant density of irradiated DNA. All the wavelength-effect curves showed a slight variation of the radiation efficiency in the range 2600 to 2800 Å, and a well-defined peak at 2800 Å. (BBB)

30943 SOME IMMUNOLOGICAL PROPERTIES OF GUINEA PIG SKIN-SALINE SUSPENSION. III. SKIN LESIONS PRODUCED IN GUINEA PIGS BY RABBIT DERMATOTOXIC SERUM. Rudzki, E. (Warsaw Medical Academy); Lagerloef, B.; Nilzen, A. Acta Dermato-Venerol., 46: 477-88(1966).

Dermatotoxic serum was injected both into guinea pigs previously sensitized to normal rabbit plasma proteins and into ^{60}Co γ-irradiated animals (in which the immune response was depressed) to investigate the skin lesions in guinea pigs produced by rabbit dermatotoxic serum. The guinea pigs were irradiated with a teletherapy unit at 70-cm source-to-center distance. The field size was 19 × 19 cm and each animal was given 300 R at a rate of 160 R/min. This technique resulted in homogeneous irradiation of the animals with an average absorbed dose of 280 ± 30 rad (using 0.94 rad/R as conversion factor). Leukopenia, which reached its peak between three and four days after irradiation, was observed, the count of white blood cells being reduced 55 to 80% below normal. The loss of weight did not exceed 8%. Between six and 10 days after irradiation, one-third of the guinea pigs died. Dermatotoxic serum was injected on the third day after irradiation. Results showed that dermatotoxic dermatitis was neither enhanced by previous sensitization of recipients to rabbit plasma proteins nor inhibited in irradiated animals. Thus, a major role of sensitization of guinea pigs to dermatotoxic sera in the mechanism of dermatotoxic dermatitis was unlikely. Rabbit antisera against guinea pig spleen suspension and guinea pig kidney suspension provoked similar lesions whereas normal rabbit serum and rabbit antiserum against guinea pig plasma proteins did not show dermatotoxic activity. (BBB)

30944 IMMUNE REACTIVITY PRIOR TO DEVELOPMENT OF THYMIC LYMPHOMA IN C57BL MICE. Doell, Ruth G.; de Vaux St. Cyr, Christiane; Grabar, Pierre (Stanford Univ., Calif. Institut de Recherches sur le Cancer, Villejuif, France). Int. J. Cancer, 2: 103-8(Mar. 15, 1967).

The immune response of C57BL mice was tested following treatment with either x radiation or methylcholanthrene. Response to a weak histocompatibility antigen difference (male to female skin grafts) was found to be depressed after both treatments, as was the response to a strong (H2) antigen difference as measured by the Simonsen graft-versus-host reaction. The potent immunodepressant drug 6-mercaptopurine was found to be carcinogenic in this strain of mouse, inducing approximately 29% thymic lymphomas when given to young mice. Females of the high spontaneous lymphoma strain AKR were found to have a markedly decreased ability to reject male skin grafts as compared with the C57BL strain. (auth)

30945 BONE MARROW ORIGIN OF IMMUNOLOGICALLY COMPETENT LYMPHOCYTES IN THE RAT. McGregor, Douglas D. (Case Western Reserve Univ., Cleveland). J. Exp. Med., 127: 953-66(May 1, 1968).

Rat bone marrow is deficient in immunologically competent cells when compared with the peripheral pool of circulating small lymphocytes. However, circulating lymphocytes capable of initiating a lethal graft vs. host reaction can develop from myeloid precursors. In adult rats inoculated at birth with parental strain bone marrow cells, the thoracic duct lymph contains cells having the immunological capability of the marrow donor. The evidence suggested that immunologically competent lymphocytes derive from cells normally resident in bone marrow and probably not from precursors in the peripheral lymphocyte pool. (auth)

30946 BIOCHEMICAL STUDIES OF RADIATION DAMAGE. I. INACTIVATION OF THE pH_5 FRACTION IN AMINO ACYL sRNA SYNTHESIS IN VITRO AND THE BINDING OF AMINO ACIDS WITH PROTEIN AND NUCLEIC ACID BY GAMMA-RAY IRRADIATION. Yamamoto, Osamu (Hiroshima Univ.). Int. J. Radiat. Biol., 12: 467-76(Oct. 12, 1967).

The pH_5 enzyme fraction obtained from yeast cells was irradiated alone with γ rays. After the addition to a reaction mixture and incubation, the inactivation mode of the enzymatic activity of phenylalanyl sRNA synthesis in vitro was sigmoidal as a function of log dose. When the enzyme fraction plus the reaction mixture were irradiated, unusual bindings of amino acid with protein and sRNA occurred. The amino acids bound abnormally by irradiation were specifically limited to those having a resonance ring, or those containing sulphur atoms. (auth)

30947 COMPARATIVE ULTRAFILTRABILITY OF CALCIUM AND STRONTIUM IN HUMAN PLASMA. Szymendera, J.; Madajewicz, S. (Inst. of Oncology, Warsaw). Nature (London), 217: 968-9(Mar. 9, 1968).

Reports on this subject have been conflicting, some indicating no difference in the filtrability and others indicating that Sr filters to a greater extent. Some experimental work employing ^{87m}Sr is described. The ^{87m}Sr was injected intravenously into ten subjects, and blood samples taken 5 to 10 min. after injection. Anaerobic ultrafiltration was carried out on the fresh plasma. Plasma Ca and ultrafiltrate Ca were determined by a standard method, and the amounts of ^{87m}Sr in the plasma and ultrafiltrate were measured in a scintillation spectrometer. Percentage ultrafiltrabilities were then calculated. The percentages of ultrafiltrable Ca and Sr were found to be similar. It is concluded that the distribution of Ca and Sr in the plasma was similar. These results are of importance in Ca–Sr discrimination studies, particularly in regard to determination of bone accretion rates. (UK)

30948 CROSS-PLACENTAL TRANSFER OF SELECTED ACTINIDES IN THE RAT. Sikov, M. R.; Mahlum, D. D. (Battelle Memorial Inst., Richland, Wash.). Contract AT(45-1)-1830. Health Phys., 14: 205-8(Mar. 1968).

Pregnant rats were injected intravenously after 15 or 19 days of gestation with colloidal suspensions of ^{239}Pu or with citrated solutions of ^{239}Pu, ^{237}Np, or ^{235}U, and the concentration of the actinide was determined in several maternal and fetal tissues 24 hours later. The retention in the placenta and fetal membranes was influenced by the specific nuclide and physico-chemical form administered. Only a small fraction of the injected nuclides entered the fetus, and their distributions within the fetus were dissimilar to those found in the dam. Of particular note was the relatively high concentration of plutonium found in fetal bone after administration of a citrated solution to the dam. (auth)

30949 DIFFUSION PROCESSES INVALIDATING THE INTRA-ARTERIAL ^{85}Kr BETA-PARTICLE CLEARANCE METHOD FOR MEASUREMENT OF SKIN BLOOD FLOW IN MAN. Sejrsen, Per (Bispejerg Hospital, Copenhagen). Circulation Res., 21: 281-95(Sept. 1967).

The use of the radioactive inert gas Kr as a tracer in the measurement of skin blood flow was carried out by intraarterial injection of ^{85}Kr dissolved in a 0.9% saline solution, and external recording of the β-radiation that penetrated only the superficial layer, to about 1 mm in thickness. This method was employed to develop a quantitative method for measurement of skin blood flow in man. The experiments were performed on normal subjects ranging in age from 24 to 76 years who received 2 mCi/ml ^{85}Kr solution (2 to 6 ml), injected into the femoral artery. The β particles were measured over the skin of the crus. Cutaneous mean blood flow was calculated using the integral equation of Zierler based on the mean transit time analysis of clearance curves recorded from the cutaneous tissues. These calculations gave estimates that were only about one-fifth those obtained by other methods. The low estimates were caused by an intercompartmental exchange of ^{85}Kr between the cutaneous and subcutaneous tissues, an exchange implying that both tissues influence the shape of the clearance curve recorded from the cutaneous tissue alone. This intercompartmental exchange was effected not only by diffusion directly from the cutaneous to the subcutaneous tissue, but presumably also by transport from the blood streaming between the two tissues. The clearance rate of the tail of the curve was shown to correspond to that of the subcutaneous tissue. The errors distorting the clearance curve of β particles may invalidate the use of intraarterial injection and measurement of clearance curves of β particles for measurement of blood flow in other tissues. (BBB)

30950 DISTRIBUTION OF ^{144}Ce IN THE FETAL AND NEWBORN RAT. Mahlum, D. D.; Sikov, M. R. (Batelle-Northwest, Richland, Wash.). Health Phys., 14: 127-9(Feb. 1968).

Pregnant rats were injected intravenously with ^{144}Ce, killed at various times afterwards, and a number of tissues assayed for radioactivity. The concentration of ^{144}Ce in the fetus was significantly lower than in the dam, while there was a substantial accumulation in the placenta and fetal membranes, suggesting the existence of a placental barrier. A substantially greater fraction of the body burden was present in the skeletons of the fetal and newborn rats than of the adults. (auth) (UK)

30951 DECREASED NUCLEOTIDE CONTENT AS THE CAUSE OF DECREASED ATP SYNTHESIS IN THYMUS NUCLEI AFTER IRRADIATION. Betel, I. (Radiobiological Inst. TNO, Rijswijk, Netherlands). Int. J. Radiat. Biol., 12: 459-66(Oct. 12, 1967).

Previous demonstrations suggested that re-synthesis of ATP in rat-thymus nuclei decreased shortly after moderate doses of x radiation. It was concluded that nuclear oxidative phosphorylation was inhibited by x irradiation, and this inhibition was implicated in the mechanism leading to interphase death. It was demonstrated here that the rates of nuclear ATP synthesis and utilization in isolated thymus nuclei were not affected by whole-body x irradiation. Irradiation caused a loss of nucleotides from cells as well as from nuclei. The resulting decrease in ATP content could completely explain the decreased re-synthesis of ATP previously reported. (auth)

30952 DNA BREAKS IN COLIPHAGE T_7 AFTER IRRADIATION WITH ARGON NUCLEI. Dewey, D. L. (Mount Vernon Hospital, Northwood, Eng. Univ. of California, Berkeley). Int. J. Radiat. Biol., 12: 497-503(Oct. 12, 1967).

Bacteriophage T_7 was irradiated with atomic nuclei accelerated in a heavy ion linear accelerator. Plaque-forming ability was measured after irradiation, using a number of different nuclei. The ultra-violet absorption of isolated phage DNA was measured in an analytical ultracentrifuge and was used to measure the proportion of double- and single-strand breaks in the DNA. (auth)

30953 EARLY INTRACELLULAR EVENTS IN THE REPLICATION OF T4 PHAGE DNA. IV. HOST-MEDIATED SINGLE-STRANDED BREAKS AND REPAIR IN ULTRAVIOLET-DAMAGED T4 DNA. Kozinski, Andrzej, W; Lorkiewicz, Zbigniew K. (Univ. of Pennsylvania, Philadelphia). Proc. Nat. Acad. Sci. U. S., 58: 2109-16(Nov. 1967).

Nicking and repair of breaks in the polynucleotide chain (PNC) of normal phage are mediated by phage-coded enzymes; uv-inactivated phage, however, is sensitive to a host enzyme that introduces single-stranded nicks into the PNC. A comparison of the sizes of single-stranded DNA fragments produced as a function of uv dose indicates that nicking may reasonably be explained as a secondary phenomenon determined by the number of radiation hits. After introduction of the single-stranded breaks, another host enzyme is able to restore the continuity of the phage PNC. Repair of the PNC continuity by the host enzyme does not restore viability of the phage. The uv-sensitive mutant of bacteria efficiently introduces nicks into the uv-damaged DNA, but the process of repair is significantly hindered. A recombination-negative mutant of bacteria is very inefficient in introducing nicks into the uv-damaged phage DNA. The radiation-sensitive $T4V_1$ mutant phage is apparently unaffected by the host enzymes. (auth)

30954 EFFECTS OF IONISING RADIATIONS ON PECTIN METHYL ESTERASES OF SOME FRUITS AND VEGETABLES. Vas, K.; Kovacs-Proszt, G.; Scheffer, H. (International Atomic Energy Agency, Vienna). Int. J. Appl. Radiat. Isotop., 19: 273-81(Mar. 1968).

Irradiation of whole fruits and vegetables with high doses (1.1 MRad) of gamma rays did not significantly change their pectin methyl esterase (PME) content as measured in the tissues macerated after treatment. The PME content of the cell sap of irradiated tissues of various fruits and vegetables, however, showed some differences. With some products residual PME activity of the sap was higher, while with others it was lower than that of the whole pulp. Crude tissue extracts, as well as extracts purified by gel filtration and dialysis, were also irradiated and examined for changes in PME activity. In contrast to the high radiation resistance of PME in whole fruits and raw extracts (ED_{50} = ca 7000 kRad at an initial PME concentration of 200 units/g). The fraction containing the enzyme in the purified state was fairly sensitive to gamma rays (ED_{50} = ca 400 kRad at the above initial PME concentration). Addition of some of the low and intermediate molecular weight fractions of the cell sap to the "pure" enzyme fraction raised the radiation resistance of the latter to about the original level of the raw extract. A possible explanation of these phenomena is discussed. (auth) (UK)

30955 EFFECT OF X-IRRADIATION ON THE ATP-INHIBITION OF PHOSPHORYLASE b. Damjanovich, S.; Suemegi, J.; Toth, S. (Medical Univ. School, Debrecen, Hungary). Experientia, 24: 351(Apr. 15, 1068).

The effects of x radiation on ATP-inhibition of phosphorylase b were analyzed and it was found that the sigmoid form of the ATP-inhibition curve was reduced following irradiation. The radiation could have had a detrimental effect on the allosteric property of the enzyme. (auth)

30956 EFFECT OF PLACEMENT DEPTH AND ROOT-INHIBITING CHEMICALS ON UPTAKE OF ^{85}Sr BY FIELD CROPS. Menzel, R. G. (Soils Lab., Beltsville, Md.); Eck, H. V.; Champion, D. F. Agron. J., 59: 70-2(Jan.-Feb. 1967).

Uptake of radiostrontium by plants from contaminated soil may be reduced by deep placement with large plows. The effectiveness of deep placement of Sr might be greatly improved if root development could be inhibited in the zone of contaminated soil. Ideally, the inhibition of root development should cause minimum reduction of crop yield and should last for many years after treatment to prevent future plant adsorption of the relatively long-lived ^{90}Sr. Experiments were conducted to determine the effect of various chemicals as root inhibitors for a single growing season. Uptake of ^{85}Sr was sharply reduced by burying it deeply enough in the soil or by burying it in contact with chemicals that inhibited root development in the contaminated zone. With soybeans, uptake of Sr from 75 cm below the soil surface was only 1% of that from 15 cm below the surface. But with sorghum, uptake from 100 cm was 40% of that from 15 cm below the surface. Application of sodium carbonate with ^{85}Sr at 50 cm reduced uptake by both crops to only a small percent of that from the same depth when no chemical was used. (BBB)

30957 EFFECTS OF X-IRRADIATION ON THE SYNTHESIS OF RAPIDLY LABELLED RNA IN AN EXPERIMENTAL TUMOUR OF THE RAT. Matsudaira, Hiromichi (National Cancer Centre Research Inst., Tokyo); Sekiguchi, Toyozo; Nakamura, Chiyoko; Hishizawa, Tokutaro. Int. J. Radiat. Biol., 13: 21-34(1967).

Effects of x radiations on the synthesis of rapidly labeled RNA were studied on Yoshida ascites hepatoma cells (AH 130) of the rat, at different intervals (0.5, 1.5, 4, 20 hours) after a whole-body irradiation of 1000 R. An increase was observed in the incorporation of ^{3}H-5-uridine into rapidly labeled RNA, notably into the RNA of high molecular weight, when the irraidated cells were labeled in vivo. In contrast, when the irradiated cells were labeled in vitro, a slight inhibition or no change was observed in the synthesis of the rapidly labeled RNA. The reason for the difference between the results of in vivo and in vitro experiments is discussed. (auth)

30958 ENHANCING EFFECT OF BONE MARROW CELLS ON THE IMMUNE RESPONSE OF IRRADIATED MICE RECONSTITUTED WITH SPLEEN CELLS FROM NORMAL AND IMMUNIZED DONORS. Radovich, Jevrosima; Hemingsen, Helen; Talmage, David W. (Univ. of Colorado, Denver). J. Immunol., 100: 756-9(Apr. 1968).

The injection of 5 million normal bone marrow cells into ^{60}Co γ-irradiated mice produced a striking effect on the size of the spleen and greatly enhanced the number of antibody-forming cells found in the spleen six days after the injection of sheep RBC and small numbers of spleen cells from normal or preimmunized mice. The experiments are interpreted as indicating a nonspecific effect of bone marrow cells on the localization or proliferation of antibody-forming cells. They negate previous claims that bone marrow enhancement can be considered evidence for a multipotential antibody-forming cell precursor. (auth)

30959 EXPERIMENTS ON THE ELIMINATION OF INCORPORATED RADIOSTRONTIUM IN GROWING RATS BY A CALCIUM DIET. Schubert, Adrienne (Univ., Vienna). Wien. Med. Wochenschr., 116: 820-4(Oct. 1, 1966). (In German).

Following administration of a high-Ca diet to rats greater amounts of Ca were excreted in urine than after feeding a low Ca diet. Average daily excretion of injected ^{90}Sr in urine and feces did not differ appreciably when these two types of diets were fed to rats. The proportion of ^{90}Sr excreted in urine to that excreted in feces ranged from a factor of two to three over an experimental study period of 30 days. A slightly larger proportion of the ^{90}Sr given was excreted by the animals that were fed with the high-Ca diet. Although there were essentially no differences in concentrations of ^{90}Sr in femur between the two groups for approximately the first 20 days, when the study was completed on day 30 there was a slightly decreased concentration of ^{90}Sr in the femurs of the animals fed the Ca-rich diet. However, these differences were small, and would require considerably more statistical analysis to be established definitely. (BBB)

30960 EFFECT OF MONOENERGETIC 14-MeV NEUTRON AND MIXED GAMMA-NEUTRON RADIATIONS ON IMMUNOELECTROPHORETIC PATTERNS OF MICE. Evans, Adelbert S.; Quinn, Frances A.; Strike, Thomas A. (Armed Forces Radiobiology Research Inst., Bethesda, Md.). Radiat. Res., 34: 49-55(1968).

Immunoelectrophoretic analyses were made on sera of C3H mice after steady-state whole-body exposures to $LD_{20(30)}$ or $LD_{80(30)}$ doses of monoenergetic 14-MeV neutrons or mixed gamma-neutron radiations. Marked differences were seen in the β_2-globulin response of the animals to the two sources during the first week postirradiation as tested by immunoelectrophoresis in agar gel. Monoenergetic 14-MeV neutron radiation at all doses resulted in augmentation of a β_2-globulin such that the precipitin line extended into the α-region. This qualitative increase was clearly evident by the third postirradiation day and appeared to be at its maximum by the fifth day. In the LD_{20} groups, there were signs of return to normal on the sixth and seventh days, but the increased component persisted throughout the experimental period in the LD_{80} animals. By contrast, the mixed gamma-neutron radiations produced little change in this β_2-globulin and that only after five days at the higher dose level. Specific staining of the immunoelectrophoretic patterns revealed the affected globulin to be a glycoprotein. (auth)

30961 EVALUATION OF THE PARAMETERS OF STRONTIUM METABOLISM IN THE RAT AS A FUNCTION OF AGE. Gusmano, E. A.; Concannon, J. N.; Bozzo, S. R.; Cohn, S. H. (Brookhaven National Lab., Upton, N. Y.). Radiat. Res., 33: 540-53(1968).

A linear two-compartment open-ended model was used to describe the kinetics of strontium in the rat as a function of age. Strontium-85 was used as the tracer in the eight age groups (39 to 389 days) studied. The numerical solution of the parameters, compartment sizes, and transfer rates was performed by the Berman (NIH-OMR-SAAM) program on an IBM-7094 digital computer. The fit of the experimental data, plasma, urine, feces, and whole-body retention to the model was unique and consistent. The parameters measured, with the exception of the urinary excretion rate, decreased as a function of age in the growing animal. The accretion rate was found to be linearly related to the rate of increase of body weight and to the total exchangeable calcium compartment. It was also demonstrated that the same model could be used, with the same degree of reliability, in man and the rat, which suggests that there is a qualitative similarity in the skeletal dynamics of both animals. The advantage of the digital computer analysis is that it affords a quantitative measure of the accuracy of the calculated parameters as well as objectivity and reproducibility. (auth)

30962 EFFECT OF LIGHT FROM A RUBY LASER ON THE METABOLISM OF SKIN IN TISSUE CULTURE. Carney, Shirley A.; Lawrence, J. C.; Ricketts, C. R. (Birmingham Accident Hospital, Eng.). Biochim. Biophys. Acta, 148: 525-30(Nov. 28, 1967).

Split thickness skin (0.15 mm) from albino guinea pigs was exposed to light from a ruby laser. Measurements with a copper cone calorimeter showed that about 40% of the light was absorbed, 40% was transmitted and 20% was reflected. After exposure to energy densities ranging from 0.4 to 2.5 J/mm^2 the skin was maintained on a medium containing radioactive isotopes in tracer amounts to enable the synthesis of intercellular substances to be measured. Graded inhibition of sulphate uptake and proline uptake was observed; 50% inhibition of both processes occurred at an incident energy density of about 2.5 J/mm^2. (auth)

30963 ELECTRON MICROSCOPY OF THE SKIN IN ROENTGEN-RAY DERMATITIS. Sosnovskii, A. T. (Minsk Medical Inst. Belorussian Inst. of Dermatology and Veneriology, Minsk. Inst. of Medical Radiology, Moscow). Med. Radiol., 12: No. 10, 59-62(Oct. 1967). (In Russian).

By means of electron microscopy, the author studied the ultrastructures of the derma and epidermic cells of healthy rabbits at 12, 24, and 72 hours, 6 and 13 days after roentgen irradiation of the skin (exposure dose — 13,860 R). There was noted an early destruction of the basal portion of the cytoplasmic membrane of basal cells, injury of cysts and of the restricting membrane of the mitochondrium, and thickening of tonofibrils. In the cytoplasm there appear transparent foci, pertinuclear vacuoles; convolution of the nuclear membrane, accumulation underneath of dense granules. Desmosomes proved to be most radioresistant. In the fibroblasts there was an early destruction of mitochondria (cysts) and gradual disappearance of structures of the cytoplasma and cytoplasmatic membrane. The collagen fibrils retained their transverse striation even in the stage of necrosis of the epidermis. (auth)

30964 EVIDENCE FOR DISCRIMINATION AGAINST TRITIUM DURING OXIDATION OF GLUCOSE VIA THE GLUCOSE-6-PHOSPHATE DEHYDROGENASE REACTION. Bartley, J. C.; Abraham, S. (Univ. of California, Davis. Children's Hospital Medical Center of Northern California, Oakland). Biochim. Biophys. Acta, 148: 563-6(Nov. 28, 1967).

Experiments were conducted on the oxidation of [1-^{3}H,^{14}C] glucose-6-phosphate by purified glucose-6-phosphate dehydrogenase and by homogenates of mammary gland from lactating rats. Results are tabulated. The value calculated for the quantity of tritium-labeled substrate remaining unoxidized in the experiment with 164 m μmoles of triphosphopyridine nucleotide was slightly greater than the amount of glucose-6-phosphate added. In the experiments with the mammary gland glucose-6-phosphate dehydrogenase, the first carbon of the tritium-labeled hexose phosphate was not appreciably oxidized until more than 30% of the ^{14}C-labeled substrate was utilized. The extent of oxidation of the tritium-labeled glucose-6-phosphate was only 1/3 that of the ^{14}C-labeled glucose phosphate when 45% of the C-1 of the substrate had been oxidized. (H.L.W.)

30965 FACTORS MODIFYING HOST RESISTANCE TO VIRAL INFECTION. III. EFFECT OF WHOLE BODY X-IRRADIATION ON EXPERIMENTAL ENCEPHALOMYOCARDITIS VIRUS INFECTION IN MICE. Murphy, Brian R.; Glasgow, Lowell A. (Univ. of Rochester, N. Y.). J. Exp. Med., 127: 1035-52(May 1, 1968).

The resistance of mice to encephalomyocarditis (EMC) virus was markedly decreased by prior exposure to whole-body x irradiation. In contrast to nonirradiated controls, the course of EMC virus infection in x irradiated animals was characterized by an enhanced mortality, shortening of the incubation period, higher levels of virus in the blood during the viremic phase and persistence of the viremia until death, failure to develop detectable serum levels of neutralizing antibody, and the earlier appearance and higher levels of virus in brain and heart tissue. The level of interferon in the serum during the course of infection was similar in both groups. The administration of relatively small quantities of anti-EMC virus neutralizing antibody to x-irradiated mice during the early phases of the infection with EMC virus restored their resistance to levels comparable to nonirradiated animals. An alteration of local organ defense mechanisms in the central nervous system could not be demonstrated. It was proposed that the inability of the x-irradiated animal to elaborate specific neutralizing antibody was a critical determinant in their failure to clear the viremia, this increase in the level and duration of the viremic phase resulted in the exposure of target organs to a greater inoculum of virus, and the enhanced mortality observed in irradiated mice reflected this greater target organ involvement. An experimental model is presented that suggests that the immunologic response is a critical determinant of host resistance during this primary systemic virus infection. (auth)

30966 FUNDAMENTALS OF RADIOCLINICAL CELL RESEARCH. Chone, B. (Univ., Heidelberg). Med. Welt, No. 1, 4-9(Jan. 1, 1966). (In German).

After itemizing the four reaction steps that may take place after irradiation, (energy absorption, formation of radiochemical products, biochemical reaction chains, and morphologically detectable secondary effects) the general relation of radiosensitivity to cell reproductive activity is discussed. Evidence for this consisted of the numerous chromosomal derangements observed after irradiation. Small doses of only 100 to 200 R produced these changes but over 20,000 R were required before changes were observed in nucleic acid components. Irradiation effects on cell components and their reactability are discussed, and methods, such as autography and radioisotope tracer techniques with ^{3}H and ^{32}P for detection and measurement of irradiation effects on cells are outlined. The relation between irradiation dose and effect are discussed for bone marrow cells. Following exposure to 200 or 300 R of ^{60}Co irradiation the first signs of marrow cell damage were detected after a latent period of 12 to 16 hr. Bone marrow reticulum was more radioresistant, and tolerated a fractionated dose of 2000 to 3000 R of ^{60}Co irradiation without loss of its reserve potential for proliferation. For this reason it comprised a starting point for postradiological bone marrow regeneration. The author discussed fluorescence microscopic methods for detection of cell changes caused by irradiation. It was emphasized that the changes observed in cells after irradiation were not entirely applicable to tumor cell kinetics. Except for transplants, tumor growth in humans was much slower than the growth of many normal tissues. (BBB)

30967 γ-IRRADIATION OF AQUEOUS SOLUTIONS OF POLYNUCLEOTIDES. Ward, J. F.; Urist, M. M. (Univ. of California, Los Angeles). Contract AT(40-1)-gen-12. Int. J. Radiat. Biol., 12: 209-18(1967).

The radioinduced degradation of aqueous oxygenated solutions of the polynucleotides of adenine, uracil, cytosine and hypoxanthine was examined by chemical methods. Adjustment of pH and temperature enabled random coil structures to be compared with double helices. Measurements of the amounts of base destroyed by irradiation showed little difference between random coil structures and mononucleotides. In the double helical structure the base moieties were protected to varying extents, and this protection appeared to be related to helix stability. The mixed double helix of poly-U poly-A was exceptional in this respect. Both bases were more sensitive to radiation when involved together in this structure. Measurement of single-chain breaks showed no dependence on macromolecular structure and only slight dependence on the base constituent of the polynucleotide. Hyperchromicity measurements of irradiated solutions showed a marked dependence of the double helix stability on the bases involved in the structure. The poly-A double helix was very stable, whereas the poly-U double helix broke down readily. (auth)

30968 HEMATOPOIETIC ORIGIN OF MACROPHAGES AS STUDIED BY CHROMOSOME MARKERS IN MICE. Virolainen, Martti (Wistar Inst. of Anatomy and Biology, Philadelphia). J. Exp. Med., 127: 943-52(May 1, 1968).

The origin of macrophages was studied in mouse radiation (x-ray) chimeras by chromosome marker technique. Macrophage cultures were established from peritoneal exudate, from lung washings, and from organ cultures of bone marrow, spleen, lymph node, thymus, and lung. Cultured macrophages were induced to divide by adding conditioned medium from L cell cultures. In chimeras that were lethally irradiated and given injections of bone marrow or spleen cells, dividing macrophages were of donor type, independent of the source of the macrophages. When chimeras were established by injections of a mixture of bone marrow cells and cells from other hematopoietic tissues of two genetically different donors, the ratio of cells with different genotypes was approximately the same in bone marrow cells and in macrophage cultures. Thymus, lymph node, and peritoneal exudate cells were not found to contain precursor cells for macrophages. Precursor cells for macrophages and for bone marrow cells appeared to be equally sensitive to sublethal irradiation. The results indicated that macrophages from different sources can all be derived from hematopoietic tissues, and suggested that only hematopoietic tissues contain precursor cells for macrophages that are capable of in vitro division. The close relationship between the source of cells in bone marrow and in macrophage cultures suggested that, at the maturation level at which the irradiated host is repopulated, the precursor or stem cells for macrophages may be identical with those for myeloid and erythroid series of cells. (auth)

30969 HISTOLOGIC LOCALIZATION OF RADIOIODIDE IN THE RABBIT THYROID GLAND. Trolldenier, H. (Institut fuer Vergleichende Pathologie, Berlin); Worseck, M. Arch. Exp. Veterinaermed., 21: 809-19(1967). (In German).

Autoradiographs of the thyroid gland of rabbits, which were given between 6.3 and 233 μCi ^{131}I or ^{125}I as intravenous injections and killed 160 min later, were illustrated and discussed in detail. At that time all the colloid was labeled. Over the cytoplasm of the follicular epithelial cells a small radioiodide uptake occurred apically only. Most follicles (68% on the average) exhibited radioiodine uptake of the colloid, with ~30% of all follicles showing a complete blackening of the lumen. The remaining third of the follicles did not take up any radioiodine. Misinterpretations regarding this group of follicles were demonstrated by reference to glass- and wax-plate models. No relation was found to exist between the radioiodine dose administered and ratio of radioiodine-labeled and radioiodine-free follicles. Some factors which needed to be considered in the evaluation of thyroid gland autoradiographs were discussed. (BBB)

30970 HYPERFINE STRUCTURE OF THE ELECTRON SPIN RESONANCE SPECTRUM OF IRRADIATED GLYCINE IN THE TEMPERATURE RANGE BETWEEN 330 AND 77°K. Reitboeck, H. (Max-Planck-Institut fuer Biophysik, Frankfurt am Main). Biophysik, 4: 15-22(1967). (In German).

The EPR spectrum of x-irradiated glycine single crystals was investigated in the temperature range between 330° and 77°K. It was established that the transition of the spectrum observed at room temperature to the spectrum at 77°K passes through an intermediate stage that is discussed. (tr-auth)

30971 INACTIVATION AND MUTAGENESIS ON ISOLATED DNA. III. ADDITIVITY OF ACTION OF DIFFERENT AGENTS ON TRANSFORMING DNA. Bresler, S. E.; Kalinin, V. L.; Perumov, D. A. **(Inst. of High Molecular Weight Compound, Leningrad). Mutat. Res., 5: 209-15(Mar.-Apr. 1968).**

Additivity of the successive actions of different agents on the transforming DNA of Bacillus subtilis (uv irradiation + nitrous acid, deoxyribonuclease + nitrous acid, nitrous acid + dimethylsulfate, deoxyribonuclease + uv irradiation) was demonstrated in spite of different molecular mechanisms of their actions. This additivity is revealed by an apparent increase in DNA resistance to the action of the subsequent agent because of the inactivation by the first agent. This increase in resistance is predicted quantitatively by the recombination theory of DNA inactivation proposed earlier. The additivity of the actions of different inactivating agents shows that the detailed mechanism of DNA damage is irrelevant for the kinetics of inactivation. The important point is the diminution in genetic lengths of DNA molecules because of their damage by any chemical agent. (auth)

30972 INACTIVATION OF RIBONUCLEASE BY X RADIATION IN ITS DEPENDENCE ON THE WATER CONTENT. Sommermeyer, K.; Schnepel, G. H.; Buss, R. **(Radiologisches Institut, Freiburg i. B.). Biophysik, 4: 129-36(1967). (In German).**

Dry and damp RNAase with a water content of up to 70% was x-irradiated, and the dependence of both the radical number and the inactivation rates on the dampness and the length of storage was measured. Similarly, as was established earlier for pepsin and alcohol hydrogenase, the radical number decreases rapidly with increasing water content if it was measured immediately after irradiation. The degree of inactivation increased with the water content. If the dry irradiated RNAase was suspended in a water vapor atmosphere or dissolved in water, a considerable after-effect was obtained. All activity losses caused by the water originated from the fact that the radiosensitivity of the RNAase was increased by autooxidation. Similar to the inactivation degree of pepsin and alcohol dehydrogenase, the inactivation degree of RNAase was independent of the water content during irradiation and the length of storage in the dry state. (tr-auth)

30973 IRRADIATION EFFECTS ON PEROXIDASE. Al-Jasim, Hamid Abdullah. **East Lansing, Mich., Michigan State Univ., 1966. 94p.**

Thesis.

The effect of irradiation and heat on the activity of purified horseradish peroxidase and the peroxidase of turnip macerate was studied. Two types of irradiation, gamma rays and 1 MeV electrons, were used. Also, the following factors that might affect the radiation sensitivity of the enzyme were studied; concentration of the enzyme in the reaction mixtures, pH of the reaction mixture, addition of sodium bisulfite, glucose, ferric chloride, and 3-indolylacetic acid. The guaiacol method of peroxidase assay was used, modified to allow automatic recording of the absorbance increase. It was found that heating of purified horseradish peroxidase at 60°C for five minutes did not cause any enzyme inactivation. When heating at 60°C for five minutes followed irradiation more enzyme inactivation resulted than when this heating preceded irradiation. Similarly, heating at 70°C or 80°C alone caused some enzyme inactivation, but when this heating followed irradiation, the inactivation was higher than when the same heating preceded irradiation. However, the combined effect of heat and irradiation on the peroxidase activity of turnip slurry was almost the same whether heating preceded or followed irradiation. Purified horseradish peroxidase added to turnip slurry behaved like the turnip peroxidase. The radiosensitivity of purified horseradish peroxidase was found to be pH-dependent. The doses required to obtain 63% inactivation were 2.1 to 2.6 times greater at pH 8 than at pH 5. Sodium bisulfite increased the radiosensitivity of peroxidase. 3-Indolylacetic acid also sensitized peroxidase. However, ferric chloride and glucose decreased the radiosensitivity of the enzyme. In the absence of oxygen, purified horseradish peroxidase was more resistant to gamma rays than in the presence of oxygen. (auth) (Disser. Abstr.)

30974 INFLUENCE OF MINERALS ON ^{90}Sr AND ^{137}Cs UPTAKE BY BEAN PLANTS. **Nishita, H.; Haug, R. M.; Hamilton, M. (Univ. of California, Los Angeles). Soil Sci., 105: 237-43(Apr. 1968).**

The influence of the addition of several minerals (clinoptilolite, Verxite, bentonite, illite, kaolinite, vermiculite and bauxite) on the ^{90}Sr and ^{37}Cs uptake by bean plants grown in two contaminated soils was examined. The ^{37}Cs uptake by the plants was relatively small compared to ^{90}Sr uptake with all mineral treatments. Among the minerals studied, clinoptilolite had the greatest effect on both the ^{90}Sr and ^{137}Cs uptake. The ^{90}Sr uptake was significantly reduced, while the ^{137}Cs uptake, although small, was increased. The effect of the other minerals ranged from no effect to small effects. Mineral treatment of soil either decreased the plant yield or had no effect. In no case was the plant yield increased. (auth)

30975 INHIBITION BY ALGINATES OF STRONTIUM ABSORPTION STUDIES IN VIVO AND IN VITRO. Patrick, G.; Carr, T. E. F.; Humphreys, E. R. **(Medical Research Council, Harwell, Eng.). Int. J. Radiat. Biol., 12: 427-34(Oct. 12, 1967).**

Slices of rat duodenum were incubated in a medium containing sodium alginate and tracer amounts of ^{85}Sr and ^{45}Ca. Alginate inhibited the uptake of ^{85}Sr by the slices more than it did that of ^{45}Ca. The uptake of ^{85}Sr decreased as the guluronic acid content of the alginate increased, but the uptake of ^{45}Ca was not affected. The degree of polymerization of the alginate had no influence on the uptake of either isotope. When fed to rats at 10% of the diet, an alginate containing 97% of guluronic acid decreased the absorption of ^{85}Sr to 0.16 of the control value without significantly changing calcium absorption. The rat intestinal wall was shown to be impermeable to this alginate by the everted sac technique. (auth)

30976 MEASUREMENT OF VENTILATION RATES WITH RADIOACTIVE TRACERS. Gerrard, Martha. **Isotop. Radiat. Technol., 5: 278-80(Summer 1968).**

The published literature indicates that the nuclides most used for studying ventilation rates are the radioisotopes of the noble gases. Of these, 10.8-year ^{85}Kr is the most convenient because it can be stored until needed. (auth)

30977 MELATONIN'S EFFECT ON ^{131}I UPTAKE BY THE THYROID GLANDS IN NORMAL AND OVARIECTOMIZED RATS. **De Prospo, Nicholas D.; De Martino, Louis J.; McGuinness, Eugene T. (Seton Hall Univ., South Orange, N. J.). Life Sci., 7: 183-8(Feb. 1, 1968).**

Incorporation of ^{131}I by the thyroid as influenced by melatonin, and the possible role of the ovaries, was studied in 23-day-old Sprague-Dawley rats. Some rats were ovariectomized and received daily injections of 10 μg of melatonin for 28 days. On the 29th day of the experiment, each rat was given an injection of 0.1 μCi of ^{131}I/100 g of body weight. After 28 hours, the rats were killed and the thyroid glands and ovaries were removed and the radioactivity measured. The thyroid weights in animals treated with melatonin did not differ significantly from their respective controls, but these organs in ovariectomized rats were heavier than in intact rats. The ovaries of melatonin-treated rats weighed less than those of the controls, significantly so when the ovary weights were expressed per unit of body weight. Ovariectomized rats were significantly heavier than intact animals at the end of the experiment and both melatonin-treated groups demonstrated a significantly greater weight gain than their respective controls. The ^{131}I uptake was definitely higher in ovariectomized animals than in the intact groups. Melatonin depressed the ability of the thyroid to take up radioiodine in all such treated rats. The amount of ^{131}I taken up by the ovaries was small, and there was no difference between melatonin-treated animals and controls. It was concluded that melatonin had an inhibitory effect on thyroid function. However, the original assumption that the effect of melatonin on the thyroid was mediated by the ovary appeared to be untenable in the light of these results. (BBB)

30978 METABOLISM OF RADIOACTIVE CESIUM (^{134}Cs AND ^{137}Cs) AND POTASSIUM BY DAIRY CATTLE AS INFLUENCED BY HIGH AND LOW FORAGE DIETS. **Johnson, James E.; Ward, Gerald M.; Firestone, Estes; Knox, Kirvin L. (Colorado State Univ., Fort Collins). J. Nutr., 94: 282-8(May 1968).**

The relation between the crude fiber content of the ration and the metabolism of fallout ^{137}Cs in dairy cattle was investigated. Ten lactating Holstein cows were fed a high hay (80%) or high grain (80%) ration. It was found that ^{137}Cs was excreted principally via the feces as compared with potassium which was largely excreted in the urine. Tracer doses of soluble ^{134}Cs were transferred to milk and urine to a greater extent than fallout ^{137}Cs. A marked decrease in absorption was noted when the dose was administered with a high hay ration as compared with a high grain ration, which was apparently due to adsorption by fibrous components of the ration. The mean transfer coefficients of fallout ^{137}Cs to milk (pCi per liter/total daily intake in pCi) were 0.48 for the high hay and 1.21 for the high grain ration. Tracer doses of ^{134}Cs showed transfer coefficients of 0.92 and 1.36 when added to the same rations. Difference in absorption of K and ^{137}Cs as judged by transfer to milk and urine could be explained on the basis of a lower absorption of ^{137}Cs due to its physical form in fallout-contaminated forages. (BBB)

30979 METABOLIC STUDIES WITH SELENIATED COMPOUNDS. II. TURNOVER STUDIES WITH ^{75}Se–METHIONINE IN RATS. Sternberg, J.; Imbach, A. (Univ. of Montreal). Int. J. Appl. Radiat. Isotop., 18: 557-68(Aug. 1967).

Tracer amounts of ^{75}Se-methionine were injected intravenously into adult female rats and the turnover of labeled plasma proteins, as well as the distribution of the isotope in subcellular fractions of the liver were studied between 5 min and 6 hr after administration. Plasma proteins rapidly incorporated the labeled amino-acid; the largest amount of ^{75}Se was found in the α globulin, followed by the γ globulin. The rate of incorporation remained unchanged in animals with sub-total hepatectomy, and even in those with total hepatectomy; moreover, a small proportion of seleno-methionine was bound to plasma proteins after incubation in vitro with total blood. The results suggest that the biosynthesis of plasma proteins can take place by transpeptidation between the circulating proteins and the free amino-acids. This does not preclude the template assembly of amino-acids on the ribosome, but offers the possibility of both mechanisms acting simultaneously in some cases. Supplementary evidence is offered by the fact that the microsomal fraction of the liver did not exhibit any significant increase of ^{75}Se during the period of time when the amino-acid is supposed to be bound to the ribosome, but not yet released into the circulation. It was not established whether the mechanism of transpeptidation is quantitatively important, and also whether it is peculiar to seleno methionine or is a more generalized phenomenon. There was no pulmonary excretion of ^{75}Se after intravenous injection of ^{75}Se-methionine, in contrast to the significant lung excretion of isotope after administration of selenite; the main excretion route of seleno-methionine is the kidney; fecal and biliary excretion were lower during the first 6 hr after administration. The highest differentiation between pancreas and liver was obtained in the rat at 3 hr after injection of ^{75}Se-methionine, while the highest difference between pancreas and blood occurred at 1 hr after injection. Thus, if animal results can be extrapolated to humans, it might be advisable to make an early scanning in cases of severe pancreas congestion. (auth) (UK)

30980 METABOLISM OF RADIOCAESIUM DURING GESTATION AND LACTATION AS INFLUENCED BY FERRIC CYANOFERRATE (II). Havlicek, F. (Kernforschungszentrum, Karlsruhe, Ger.). Int. J. Appl. Radiat. Isotop., 19: 487-8(May 1968).

It was shown that oral administration of ferric cyanoferrate (II) (FCF) leads to diminished enteral reabsorption of radiocaesium and thus to a marked reduction of body burden. The study described was concerned with the effect of FCF in rats during gestation and lactation. Animals were injected intraperitoneally with ^{137}CsCl two days prior to mating (first group), and immediately after parturition (second group). One half of each group was maintained on a standard diet, and the other half on pellets containing 1% FCF. Retention of ^{137}Cs was assayed over a 3 week period following injection. Findings included the following: (i) FCF is highly effective in decreasing the fraction as well as the half-time of retention; (ii) excretion of ^{137}Cs is enhanced during gestation, and particularly during lactation; (iii) the diminished retention in lactating animals is only partly due to excretion with milk, and a generally enhanced turnover has to be assumed; (iv) there is complete additivity between the effect of FCF and that of gestation and lactation. (UK)

30981 MORPHOLOGY OF POST-IRRADIATION CHANGES IN BREAST CANCER. Lysakowska, Janina; Laskowski, Josef Nowotwory, 18: 17-32(Jan.-Mar. 1967). (In Polish).

Microscopic patterns of breast cancer from 200 cases treated before surgery with high doses of x-rays were compared before and after irradiation. The postirradiation changes in the stroma and in the surrounding glandular tissue of the tumor were described. Attention has been paid to the cellular forms unable to divide such as colostrum—like cells and multinuclear cells, as well as to diffused cytoplasmatic masses. In 24 cases the remains after destruction of the carcinoma due to irradiation was found. This site, denoted as post-carcinoma focus was morphologically described in detail, attention being paid to the role of elastosis in the diagnosis. It is emphasized that a post-carcinoma focus plays an essential role in a morphological proof for sterilization of the mamma by means of ionizing energy. It was observed that the most frequent occurrence of the small cellular, partially glandular tumor patterns was among cases, in which no morphological features of damage after irradiation was stated. It can be assumed that it may be due to its lesser radiosensitivity. (auth)

30982 MECHANISM OF ACTION OF CERULOPLASMIN IN INHIBITING ASCORBIC ACID-INDUCED DEPOLYMERIZATION OF HYALURONIC ACID. Niedermeier, William; Laney, Radford P.; Dobson, Carl (Univ. of Alabama, Birmingham). Biochim. Biophys. Acta, 148: 400-5(Nov. 28, 1967).

Autoxidation of ascorbic acid in the presence of hyaluronic acid resulted in depolymerization of the polysaccharide. Degradation of diketogulonic acid, an intermediate produced in the course of autoxidation of ascorbic acid, appeared to be the reaction with which depolymerization of hyaluronic acid was associated. Enzymatic oxidation of ascorbic acid by ceruloplasmin failed to result in depolymerization of hyaluronic acid. This effect of ceruloplasmin appeared to be the result of its capacity to alter the pathway of degradation of diketogulonic acid. Its failure to alter the course of depolymerization of hyaluronic acid by ionizing radiation indicated that its action was not due to destruction of free radicals. Apoceruloplasmin, serum albumin and haptoglobin had no influence on ascorbic acid-induced depolymerization of hyaluronic acid. (auth)

30983 METHOD OF RADIO-IODINATION ON A SUBMICROGRAM SCALE. THE PREPARATION AND STABILITY OF ^{131}I- AND ^{125}I-LABELLED 3-MONOIODOTYROSINE AND 3,5-DIIODOTYROSINE OF VERY HIGH SPECIFIC ACTIVITY. Brown, B. L.; Reith, W. S. (Middlesex Hospital Medical School, London). Biochim. Biophys. Acta, 148: 423-34(Nov. 28, 1967).

Iodine-131- and ^{125}I-labelled monoiodotyrosine and diiodotyrosine with specific activities of around 2000 mC and 4000 mC, respectively per μmole were prepared. A new iodination method on a submicrogram scale is described in which the solutions, separated by air bubbles, are assembled in a polytetrafluoroethylene capillary tube prior to their expulsion into the reaction vessel. The reaction is complete in 45 sec. The concept of minimal specific activity and a routinely applicable method for its estimation is described. Simultaneously an estimation is obtained of the isotopic abundance in the radioiodide solution used for the iodination. The stability of these radioiodotyrosines was investigated. They are reasonably stable in the dark but unstable in ultraviolet light or under β-irradiation. Various substances accelerate or retard decomposition. There is a marked difference in behavior between monoiodotyrosine and diiodotyrosine. (auth)

30984 NATURE OF BREAKS IN THE DNA CHAIN UPON IRRADIATION ON AQUEOUS SOLUTIONS. Krushinskaya, N. P.; Shal'nov, M. I. (Inst. of Biophysics, Moscow). Radiobiologiya, 7: 24-30(1967). (In Russian).

Malonic aldehyde (MA) was identified chromatographically as a product of γ-irradiation of desoxyribose (DR), and by reaction with 2-thio-barbituric acid; it was also detected in desoxyguanosine, desoxyguanosine-3′ and -5′-phosphates, and DNA. Malonic aldehyde concentration increased with dose up to a high limit where radiolysis apparently occurred. Approximately half of the free DR molecules break down with formation of MA, whose yield drops with molecule complexity (that from DNA is lower). According to a scheme presented for DNA breakdown yielding MA, the latter is formed at the same time bases are freed and characterizes the portion of single breaks caused by breakdown of the C3′ – C4′ bond. Phosphate yields rise with dose; below 80 krad they are less than MA, indicating breaks in the DNA chain not accompanied by phosphate yield. Increase in dephosphorylation above 80 krad indicates that primary phosphate is freed only by the splitting off of 5′-terminal phosphate groups. Relation of phosphate molar concentration to dose indicates a 2-hit reaction, as does that of dose to drop in molecular weight of 2-rod DNA. Double DNA breaks can thus be calculated by the number of freed phosphate groups (2 for 1 double break). Single breaks are independent of dose, showing the absence of a low-dose threshold; the linear dependence of double breaks on dose lowers the probability of their occurrence at low doses. Up to 10 krad, single breaks predominate and single-rod molecular weight drops. At 10 – 100 krad, double breaks also appear. Above 100 krad, double breaks predominate, causing changes in the hydrodynamics and optical properties of DNA solutions. (JPRS)

30985 NATURAL RESISTANCE OF IRRADIATED ANIMALS TO BOTULIN TOXINS. Bulatova, T. I.; Kaulen, D. R. (Inst. of Epidemiology and Microbiology, Moscow). J. Hyg. Epidemiol. Microbiol. Immunol., 10: 67-73(1966).

Irradiation of mice with 340 R lowered their natural resistance to perorally administered type A botulin toxin. With intravenous administration the sensitivity of irradiated animals to this toxin remained practically unchanged. Irradiation of mice with 340 to 700 R lowered their natural resistance to pancreatin-activated type botulin toxin administered into the alimentary tract. Animals irradiated with sublethal exposures of 340 to 700 R were found to be less sensitive than the unirradiated control animals to non-activated type E toxin administered into the alimentary tract. As in experiments with type A botulin toxin, the sensitivity of irradiated mice to intravenously administered type E botulin toxin remained practically unchanged. (BBB)

30986 NEW APPROACH TO PRECISION MEASUREMENT OF RED CELL MASS AND PLASMA VOLUME. Buchan, R. C. T.; Fenner, Matthew L. (Plymouth General Hospital, Can.). Brit. J. Radiol., 41: 317(Apr. 1968).

A method is described that uses radioisotope labeling for measurement of red cell mass and plasma volume of blood. Equations are presented that involve only quantities that may be determined without centrifugation. (M.M.B.)

30987 POST-IRRADIATION CHANGES IN AXILLARY LYMPH NODES IN BREAST CANCER PREOPERATIVELY TREATED WITH X RAYS. Laskowski, Josef; Lysakowska, Janina. Nowotwory, 18: 33-43(Jan.-Mar. 1967). (In Polish).

Detailed microscopic examination of axillary lymph nodes in 195 cases of breast cancer treated before operation with high doses of x-rays was performed. The postirradiation changes in lympho-reticular tissue were also examined in 110 cases in which the nodes were free of metastases. It was observed that the changes proceeded in two stages and that they increased with time after irradiation; the changes were characteristic enough so that they could be used to recognize whether a given node had been irradiated. Investigation of the changes in metastases of nodes revealed that they were similar to those observed in the primary tumor of the breast. Morphological features that characterize postneoplastic focus in the node are described and this was taken as proof of a possibility of complete sterilization of axillary nodes with ionizing radiation. The coexistence of sterilized nodes with those nodes with active neoplastic focuses indicated that the effectiveness of x-rays was very uneven. The metastases were more maturated as compared with the primary focus in the breast but were similarly susceptible to postirradiation damage. Sometimes (in $\frac{1}{3}$ of cases) they remained unchanged despite considerable damage to the carcinoma in the mammary gland. The greater number of nodes with metastases as well as an infiltration of the node capsule with invasion of cancer to the surroundings determined an unfavorable prognosis. (auth)

30988 PROGRESSION OF MAMMALIAN CELLS THROUGH THE DIVISION CYCLE FOLLOWING ULTRAVIOLET IRRADIATION. Bootsma, D.; Humphrey, R. M. (Toegepast Natuurwetenschappelijk Onderzoek, Rijswijk, Netherlands). Mutat. Res., 5: 289-98(Mar.-Apr. 1968).

Exposure of living cells to uv light in the 254 mμ range leads to photochemical changes in the nucleic acids. The influence of these changes on progression through the division cycle was investigated using two different cell lines: a heteroploid epithelial cell line of human kidney origin (T cell) and a diploid Chinese hamster fibroblast (DON cell). The duration of the cell cycle of these lines was 24–26 and 10–12 h respectively. Synchronous and asynchronous cultures were used. Cells irradiated in late G_2 phase with doses of 100 erg/mm^2 or less were not or only slightly delayed in entering mitosis. Mitotic delay increased when the cells were irradiated earlier in G_2. Exposure in S phase was followed by an inhibition of DNA synthesis, leading to a lengthening of S (4–5 h after a dose of 35 erg/mm^2) and delay of cell division. This inhibition increased if irradiation was carried out earlier in S phase. After exposure of T cells in G_1 phase, which has a relatively long duration, the cells started earlier with [^{3}H] thymidine incorporation. This incorporation indicates a shortening of G_1 phase rather than an unscheduled synthesis of DNA. In general these data suggest that the uv-induced changes in the nucleic acids (at a relatively low dose level) mainly interfere with DNA replication in S phase and do not or only slightly inhibit progression through other parts of the cell cycle. (auth)

30989 PREPARATION AND IMMUNOLOGICAL PROPERTIES OF ^{131}I-LABELLED ADRENOCORTICOTROPHIN. Landon, J. (St. Mary's Hospital, London); Livanou, Theodora; Greenwood, F. C. Biochem. J., 105: 1075-83(Dec. 1967).

A procedure is described for preparing ^{131}I-labeled adrenocorticotrophin suitable for use in radioimmunoassay. Adsorption of labeled and unlabeled adrenocorticotrophin at low concentrations occurs on various surfaces despite the presence of dilute protein. Adsorption and desorption errors are minimized by low pH and by the use of polystyrene vials. Preparations with low initial damage are obtained if the radioiodination is performed rapidly and the separation of ^{131}I-labeled adrenocorticotrophin from unchanged ^{131}I iodide is carried out on cellulose columns by using dilute acid. The immunological activity of ^{131}I-labeled α^{1-24}-adrenocorticotrophin, but not of ^{131}I-labeled porcine adrenocorticotrophin, decreased with increasing specific radioactivity. The involvement of tyrosine residues in the immunological specificity of the α^{1-24}-adrenocorticotrophin only is suggested to explain this finding. (auth)

30990 RADIATION DAMAGE TO CRYSTALLINE RIBONUCLEASE: IDENTIFICATION OF POLYPEPTIDE CHAIN BREAKAGE IN THE DENATURED AND AGGREGATED PRODUCTS. Haskill, J. S.; Hunt, J. W. (Univ. of Toronto. Ontario Cancer Inst., Toronto). Radiat. Res., 32: 827-48(1967).

Gamma-irradiated crystalline ribonuclease was chromatographically separated into three distinct components classified as denatured, aggregated, and native, on the basis of the physical alterations which occurred in the conformation of these molecules. Chromatography on G-75 Sephadex failed to reveal the presence of any low-molecular-weight products in the irradiated enzyme. However, after reduction of the disulfide bridges in mercaptoethanol and chromatography on G-75 Sephadex, low-molecular-weight products indicative of polypeptide chain breakage were detected from both the denatured and the aggregated products. The presence of fragments of the reduced protein was confirmed by velocity sedimentation measurements. Fragments were not observed from the native component, which was known to contain partially damaged molecules. These results indicated that polypeptide chain breakage occurred on exposure of RNAase to ionizing radiation but that it was masked by the presence of disulfide bonds. Evidence was obtained which suggested that free amide groups were produced as a result of the breakage of the polypeptide chain. A high yield of fragments was observed following irradiation in H_2S and in vacuo. The inability of H_2S to prevent the main-chain breakage suggested that this cleavage occurred at an early step in the radiation process. It was concluded that the rupture of the polypeptide chain was an important factor, but not the exclusive cause of the inactivation of crystalline ribonuclease by ionizing radiation. (auth)

30991 RADIAL DIFFUSION AND POWER FUNCTION RETENTION OF ALKALINE EARTH RADIOISOTOPES IN ADULT BONE. Marshall, J. H.; Onkelinx, C. (Argonne National Lab., Ill.). Nature (London), 217: 742-3(Feb. 24, 1968).

The retention of alkaline earth radioisotopes in skeletal systems can be approximated by the power function $R = \epsilon^b(t + \epsilon)^{-b}$, where b is a fraction between 0 and 0.5, t is time after intravenous injection, and ϵ is a time of the order of 1 day (for adult man and dog). A physiological explanation for this form of retention function is offered, which may be applicable to normal adult bone, based on a slow radial diffusion process through complex material consistency of collagen, bone crystals, etc. Data were obtained for ^{45}Ca, ^{90}Sr, and ^{226}Ra. (UK)

30992 RADIOIRON CONTENT OF EPITHELIUM AND CELL TURNOVER IN PSORIASIS. IRON EXCRETION IN MAN. II. Reizenstein, Peter; Skog, Erik; Stigell, Paer (Karolinska Sjukhuset, Stockholm). Acta Dermato-Venerol., 48: 70-4(1968).

Radioiron metabolism was studied in five cases of psoriasis to assess the greatest radioiron loss that could result from desquamation of epidermal cells, and to determine if it were possible to estimate the radioiron turnover time of epidermal cells. Measurements were performed by a whole-body counter with a background shield of 15 cm of steel, 3 mm of lead, and two scanning NaI detectors 5 in. in diameter and 3 in. thick. Each patient received 2 μg of iron and 9 to 10 μCi of ^{59}Fe as ferric citrate by intravenous injection. Urine and feces were collected quantitatively for 15 to 20 days. Radioiron losses via the desquamated epithelium in five cases of exfoliative dermatitis were also measured. Daily determinations were made of the radioactivity of the scales, urine, and feces and whole-body counts were performed at the same time. The losses via the skin ranged from 0.2 to 2.6% of the ^{59}Fe dose; the corresponding values for urine were 0.8 to 2.2%, and for feces 0.7 to 5.8%. A peak activity in the desquamated epithelium observed in all patients on the second and fourth days was indicative of a rapid turnover time of radioiron in the epidermal cells. (BBB)

30993 REGULATION OF ALBUMIN SYNTHESIS AND CATABOLISM BY ALTERATION OF DIETARY PROTEIN. Kirsch, R.; Frith, L.; Black, E.; Hoffenberg, R. (Univ. of Cape Town). Nature (London), 217: 578-9(Feb. 10, 1968).

Measurements were made of the plasma albumin pool and of the synthesis and catabolic rates in rats given diets containing little or no protein, and similar measurements were made in rats re-fed a normal diet after being deprived of protein. The plasma albumin pool was calculated from the product of albumin concentration and plasma volume as determined by isotope dilution using ^{131}I-albumin. Synthesis rate was measured by a method based on the relative rates of incorporation of ^{14}C into urea and into the guanidine carbon of albumin arginine. Rat albumin labeled with ^{131}I was administered intravenously to measure catabolic rate, calculated from urinary loss of activity. Iodide was added to the drinking water in order to block uptake of ^{131}I by the thyroid. ^{14}C-carbonate was also employed in measurements of synthesis rate. (UK)

30994 ROLE OF HYDRATED ELECTRONS IN THE PRODUCTION OF CHEMOLUMINESCENCE IN AQUEOUS DYES BY X-RADIATION AND ELECTRON PULSES. Pruetz, W.; Sommermeyer, K. (Univ., Freiburg i. B.). Biophysik, 4: 48-62(1967). (In German).

The luminescence of highly diluted dye solutions produced by x rays of 8.5 and 24 keV and the phosphorescence produced in the solutions by 4-MeV electron pluses, especially their dependence on the research parameters, dye concentration, and concentration of quenching substances, were compared. The greatest part of the luminescence produced by x radiation represented a chemoluminescence that showed a dependence on the reaction capacity of the quenching substance with e^-_{aq} or OH radicals similiar to the phosphorescence produced by electron pulses. The analogies were discussed. It was concluded that dye concentrations that were directly proportional such as the concentration of the e^-_{aq} and OH were approximately equivalent with respect to the chemoluminescence yields and possessed equal light yield. It is therefore probable that in both cases the light excitation was caused by the same chemical reaction. The analogy was extended to the sensitization of chemoluminescence by I^-. Chemoluminescence and direct excitation of the dyes by electron collision showed a dependence on the LET. (tr-auth)

30995 REGENERATIVE POTENTIAL OF IMMUNOCOMPETENT CELLS. II. FACTORS INFLUENCING RECOVERY OF SECONDARY ANTIBODY-FORMING POTENTIAL FROM X-IRRADIATION. Nettesheim, P.; Williams, M. L. (Oak Ridge National Lab., Tenn.). J. Immunol., 100: 760-70(Apr. 1968).

Mice were primed by intraperitoneal or intravenous injection of rat or sheep red blood cells. A fixed number of spleen cells from primed donors was transferred into isologous recipients irradiated with 800 R. Three types of studies were carried out: secondary response profile of intact mice, secondary antibody-forming potential after irradiation as a function of the priming dose and the priming-x-irradiation interval, and effect of a noncrossreacting antigen, given shortly after irradiation, on the recovery of secondary antibody-forming potential. Results are presented in the form of graphs. The following conclusions were made: Whether or not the antibody-forming capacity of a primed animal recovers from an x-ray insult depends on the type and amount of antigen given for priming, the priming-x-irradiation interval, and the x-ray dose. The memory cell compartment lacks the potential to recover from an x-ray insult by way of self-generation. Recovery of the memory cell pool does occur, however, provided immunogen persists until uncommitted progenitor cells again become available and are stimulated to form memory cells. Thus the recovery of the memory cell compartment is a reflection of regenerating uncommitted progenitor cells. (H.L.W.)

30996 REACTIONS OF PROTEINS WITH HYDRATED ELECTRONS: THE EFFECT OF CONFORMATION ON THE REACTION RATE CONSTANT. Braams, R. (Univ., Utrecht); Ebert, M. Int. J. Radiat. Biol., 13: 195-7(1967).

Experiments performed with RNAase and gelatin at elevated temperatures indicated the general importance of conformation to the reactivity of macromolecules. The surprisingly large change with temperature of the reactivity of the hydrated electron with RNAase suggested an important shielding factor attributable to the tertiary structure of this molecule. The findings may be relevant to the detailed interpretation of data on radiation effects in DNA in vivo and in vitro, since this macromolecule can appear in different conformations in different stages of a life-cycle. (C.H.)

30997 RADIOIMMUNOASSAY OF ANGIOTENSIN. Hollemans, H. J. G.; van der Meer, J.; Touber, J. L. (Univ. of Amsterdam). Nature (London), 217: 277-8(Jan. 20, 1968).

It was shown that antibodies elicited in rabbits by copolymers of angiotensin with poly-l-lysin can be used for radioimmunoassay of angiotensin. Some experimental studies on this subject are described. Comparing the binding affinity of three different rabbit antisera to Val^5-angiotensin II amide (Hypertensin) and three analogues, it was found that these antisera do not behave identically quantitatively. This finding has important consequences for the standardization of immunoassays of angiotensin in human plasma. Labeling with ^{125}I was employed in the studies. (UK)

30998 RADIOTUNGSTEN RETENTION BY TWO INSECT SPECIES. Kaye, S. V.; Crossley, D. A. (Oak Ridge National Lab., Tenn.). Health Phys., 14: 162-5(Feb. 1968).

It is stated that tungsten has received little study from the biological aspect. A need exists for a better knowledge of the movement of tungsten in different environments, since its radioisotopes are among the most abundantly produced radionuclides from Plowshare-type nuclear devices. Radioisotopes of tungsten are produced as activation products of device components. Studies are described on the uptake of radiotungsten (^{187}W) by the adult brown cricket species Acheta domesticus and the large milkweed bug Oncopeltus fasciatus. Absorption from drinking water appeared to be almost complete, but uptake from food appeared less. Biological half-times, based on mean retention times, were 48 hr for Acheta and 58 hr for Oncopeltus. Accumulation and retention patterns showed some similarities with radiocaesium. Suctorial insects such as Oncopeltus may possess ion conservation mechanisms which enhance retention of these radioisotopes in comparison with chewing insects such as Acheta. (UK)

30999 RELATIVE BINDING OF STRONTIUM AND CALCIUM IN PROTEIN AND NON-PROTEIN FRACTIONS OF SERUM IN THE RABBIT. Lloyd, E. (Medical Research Council, Oxford). Nature (London), 217: 355-6(Jan. 27, 1968).

A discrimination was reported by the author between the ratio of Sr to Ca in rabbit plasma and that in bone. This discrimination could be the result of a difference in this ratio in the protein and non-protein fractions of the plasma. If the ratio in the non-protein fractions were lower than in the plasma as a whole, then the ratio in the extracellular fluid might be expected to be lower, and hence account for the lower ratio observed in bone. In order to test this hypothesis a double tracer experiment was carried out, using ^{85}Sr and ^{47}Ca, in rabbits. The protein and non-protein fractions were separated in an ultracentrifuge and the $^{85}Sr/^{47}Ca$ ratio was determined for these fractions, as well as for the whole serum. The ratio was found to be the same for all fractions, indicating that the previously reported discrimination of 1.6 against Sr in the transfer between blood and bone cannot be attributed to a difference in the ratio between the protein-free plasma and the plasma as a whole. There may, however, be a difference between the relative behavior of Sr and Ca soon after administration and after a longer interval. (UK)

31000 SEARCH FOR A MECHANISM FOR THE INCREASED SENSITIVITY OF 5-BROMOURACIL-SUBSTITUTED DNA TO ULTRAVIOLET RADIATION. Lion, M. B. (Oak Ridge National Lab., Tenn.). Biochim. Biophys. Acta, 155: 505-20(1968).

The 5-bromouracil-substituted DNA's of Escherichia coli 15T⁻ and T_3 coliphage were labeled in thymine and 5-bromouracil with different isotopes and exposed to 280 nm of uv radiation. Acid and enzymic hydrolysates of the substituted DNA's of the above organisms were analyzed for photoproducts by paper chromatography. The same four or five photoproducts, derived from 5-bromouracil, were detected in the acid hydrolysate of the irradiated DNA's under all conditions tested, including irradiation in vivo and in vitro and in the presence and absence of cysteamine. No product containing both the 5-bromouracil and thymine labels were detected. Quantitative differences in the distribution of photoproducts were obtained under the various conditions of irradiation. Cysteamine, when present during irradiation, caused a decrease in the formation of uracil but had little effect on the total photodecomposition of 5-bromouracil. Also, an increase in dose caused an increase in the contribution of uracil to the total photoproducts. At low doses there was little difference between the photosensitivity of 5-bromouracil and thymine in DNA. Exposure in solution to 254 nm radiation only slightly affected the chromatographic mobility of the photoproducts derived from 5-bromouracil. The excision in vivo of thymine-containing dimers from the irradiated DNA was unaffected by the presence of 5-bromouracil in the DNA. The smaller numbers of thymine-containing dimers in irradiated DNA substituted with 5-bromouracil were quantitatively explicable in terms of the random substitution of bromouracil for thymine. The implication of these data is discussed with reference to the suggested mechanisms of the radiation sensitization of DNA by 5-bromouracil substitution. (auth)

31001 STEM CELL INACTIVATION IN MIXED SPLEEN CELL CULTURES. Petrov, R. V.; Seslavina, L. S.; Pantele'ev, E. I. (Ministry of Public Health, Moscow). Nature (London), 217: 558-60(Feb. 10, 1968).

The studies described are concerned with the effects of the presence of foreign cells on the capacity of mouse spleen cells to respond to antigenic stimulation and to give rise to hematopoietic cell colonies. The effect of irradiation on one of the components of the cell mixture is described. Spleen cells from each of two strains of mice were incubated and injected intravenously into irradiated hybrid mice. In experiments intended to study the immune response of the recipient, sheep cells were added to the spleen cell suspensions before injection into the irradiated mice. At various times after irradiation, between the sixth and eight day, the recipient mice were killed, and direct plaque assay or spleen colony counts were made. Gamma radiation was employed The results indicated that inactivation requires the active participation of both component cell types in the mixture, and that interaction between two genetically different mouse spleen cell populations in vitro leads to diminution in the capacity of one or the other, and probably both, to respond to antigenic stimuli and to function as sources of hematopoietic stem cells. The fact that the inactivation process is initiated and perhaps completed in vitro gives hope that its nature may be explored in future experiments. (UK)

31002 STUDIES ON THE BEHAVIOR OF ERYTHROPOIETIN-SENSITIVE CELLS IN THE MOUSE DURING RECOVERY FROM 200 ROENTGENS OF WHOLE-BODY IRRADIATION. **Schooley, John C.; Hayes, Judith M.; Cantor, Linda N.; Havens, Virginia W. (Univ. of California, Berkeley). Radiat. Res., 32: 875-83(1967).**

Ten days after exposure to 200 R of ^{60}Co whole-body γ irradiation the hematopoietic system of the polycythemic mouse contains three to four times as many cells available during a 6-hour period for stimulation by erythropoietin into erythroid cells as does the unirradiated mouse. The irradiated polycythemic mouse does not, however, respond to fractionated doses of erythropoietin as does the unirradiated polycythemic mouse. Paradoxically, the irradiated mouse exhibits a greater response to a small dose of erythropoietin than an unirradiated mouse, although it shows a lower response to a large dose of erythropoietin. These results are discussed relative to a model of hemopoiesis which assumes that a population of cells derived from the stem cell rather than the stem cell itself is sensitive to the differentiative action of erythropoietin. (auth)

31003 SURFACE TO VOLUME RATIOS OF BONE DETERMINED BY COMPUTER ANALYSIS OF MICRORADIOGRAPHS. **Lloyd, E.; Rowland, R. E.; Hodges, D.; Marshall, J. H. (Argonne National Lab., Ill.). Nature (London), 218: 365-6(Apr. 27, 1968).**

Communication describes the use of a computer-controlled automatic scanning device to obtain surface to volume ratios of bone sections. The interest in this ratio arose from the fact that some bone-seeking nuclides, such as ^{239}Pu and ^{241}Am deposit specifically on bone surfaces. Calculations of the relative toxicity of these nuclides compared with those which deposit throughout the whole volume of bone (such as ^{226}Ra) must include a factor for the surface/volume ratio. A microradiograph of a cross section of bone was scanned and a print-out of results was obtained within 1 min. Results are given for sections taken from the cortical portion of the femur and from trabecular bone from rib, vertebrae and the head of the femur, and surface/volume ratios are estimated for the whole skeleton. (UK)

31004 THE INITIAL UPTAKE OF IONS BY BARLEY ROOTS. III. THE UPTAKE OF CATIONS. **Barber, D. A.; Shone, M. G. T. (Agricultural Research Council, Wantage, Eng.). J. Exp. Bot., 18: 631-43(Nov. 1967).**

Experiments were carried out to determine the extent to which Rb and Sr, absorbed by excised barley roots, can be divided into discrete fractions was studied, namely, ions extractable with water, those which are exchangeable, and those remaining in the tissue. Whether the behavior of cations could be validly interpreted in terms of the electrical double-layer theory, as previously demonstrated for anions, was examined. To facilitate interpretation of the results, comparable experiments were carried out on a cation-exchange resin and on gelatin. Behavior of Sr accorded qualitatively with the theory providing allowance was made for effects due to the hydrolysis of negative sites and for the presence of positive charged in the roots. For Rb, on the other hand, the situation was much more complex. Not only was there evidence even at 0.2°C for sites which retained a high Rb specificity, but also movement of the ion due to physical diffusion was masked by concurrent metabolic activity. A meaningful separation of the over-all uptake of Rb into successive steps of exchange absorption and metabolic accumulation could not be made. (BBB)

31005 THEORETICAL CALCULATION OF THE DNA SYNTHESIS IN U. V. IRRADIATED L-CELLS AND REAL SYNTHESIS. **Klimek, M. (Inst. of Biophysics, Brno). Neoplasma, 14: 555-7(1967).**

The calculation of theoretical DNA synthesis in uv-irradiated L cells is based on the following premises: dimers are not eliminated from the DNA of uv-irradiated cells; replication starts in any replicon from one origin only; DNA in a mammalian chromosome forms many replicons, analogous to bacterial chromosomes; DNA polymerase is able to polymerize DNA from the origin up to a dimer; distribution of excitations is random and the probability of dimer induction is the same for the full length of the replicon. The theoretical curve obtained was in good agreement with the curve based on experimental values. (H.L.W.)

31006 THE WHOLE BODY AUTORADIOGRAPHIC STUDIES ON THE DISTRIBUTION OF RADIOISOTOPES. XII. DISTRIBUTION OF A LOCAL ANESTHETIC, 2-METHYL-2-n-PROPYLAMINOPROPION-o-TOLUIDE HYDROCHLORIDE (LA-012) IN GUINEA PIGS. **Sakuma, Mari; Sato, Yoshishige Radioisotopes (Tokyo), 17: 113-21(Mar. 1968). (In Japanese).**

Guinea pigs were injected subcutaneously with tritium-labeled 2-methyl-2-n-propylaminopropion-o-toluide hydrochloride, and whole-body sections 40 μ in thickness were prepared at intervals from 10 min to 24 hr after the injection. Autoradiograms revealed that the labeled anesthetic was absorbed rapidly and little or no radioactivity remained at the site of injection after 60 min. The radioactivity in the liver, kidneys, gastrointestinal contents, gall bladder, salivary glands, and infraorbital glands reached the highest level after about 30 min. This rapid accumulation was followed by a slow decline. A characteristic high accumulation and retention of radioactivity was found in various connective tissues. (H.L.W.)

31007 THE FEASIBILITY OF IN VIVO NEUTRON ACTIVATION ANALYSIS OF TOTAL BODY CALCIUM AND OTHER ELEMENTS OF BODY COMPOSITION. **Palmer, H. E.; Nelp, W. B.; Murano, R.; Rich, C. (Battelle-Northwest, Richland, Wash.). Phys. Med. Biol., 13: 269-79(Apr. 1968).**

Measurements of the γ-rays emitted from human cadavers and phantoms after exposure to relatively low levels of fast neutrons show that several elements of body composition can be determined by this procedure. These elements include calcium, sodium, chlorine, nitrogen, and phosphorus. The determination of total body calcium is one of the most important applications of this method. Results show that the calcium content in a man can be measured to an accuracy of ±8%, and that a change of 2% or more in the calcium content in the same person over a period of time can be detected. These results can be obtained with neutrons produced at a cyclotron and with radiation doses to the subject of 0.1 rad or less. A sensitive whole-body counter for measuring the γ-rays is described. (auth)

31008 TRACING WITH ACTIVABLE TRACERS. PART I. Greene, R. E. Isotop. Radiat. Technol., 5: 269-77(Summer 1968).

The use of activable stable isotopes and stable elements with various types of activation analysis for tracing is reviewed. Advantages and disadvantages of the method are given, and several examples of applications of tracing with activable tracers in medicine and biology, pollution studies, hydrology, industry, and metallurgy and related fields are described. (In several parts.) (auth)

31009 THE ACTIVITY OF SUCCINIC ACID DEHYDROGENASE, NADH CYTOCHROME C-REDUCTASE, AND L-AMINO ACID OXIDASE IN MOUSE LIVER MITOCHONDRIA AFTER IN VIVO IRRADIATION. **Waldschmidt, Marianne (Univ., Freiburg i. B.). Int. J. Rad. Biol., 12: 135-41(1967). (In German).**

One to 12 days after whole body irradiation of mice with 690 R, the activity of succinic acid dehydrogenase, NADH cytochrome c-reductase, and L-amino acid oxidase was measured in isolated liver mitochondria. The activity of the succinic acid dehydrogenase increases strongly in fasting animals, but the decrease begins the first day after irradiation when the animals have fasted for 24 hours before sacrifice. The decrease in the activity of NADH cytochrome c-reductase was more pronounced in fasting animals than in nourished animals after irradiation. In fasting mice after irradiation it oscillated around the value of fasting controls. The activity of L-amino acid oxidase was only slightly reduced in fasting mice after irradiation. In fasting irradiated animals a significant decrease, compared with the values of fasting mice alone, was found only at the eighth, eleventh, and twelfth day after irradiation. (tr-auth)

31010 THE ACTIVITY OF PHOSPHOFRUCTOKINASE AND FRUCTOSE-1, 6-DIPHOSPHATASE IN THE LIVER TISSUE OF MICE AFTER WHOLE-BODY IRRADIATION. **Brendt, Juergen; Gaumert, Renate (Univ., Freiburg i. B.). Int. J. Radiat. Biol., 12: 453-8(Oct. 12, 1967). (In German).**

The activities of phosphofructokinase (PFK) and fructose-1,6-diphosphatase (FDPase) were measured in mouse liver over a period of 17 days after whole-body x irradiation. PFK-activity is enlarged in fed mice from the 8th to the 14th day after irradiation, while in mice starved for 24 hours a continuous increase is observed from the 4th day up to a 2.5-fold increase over the unirradiated controls. This course of PFK-activity is also observed after 810 R. It is assumed that an enhanced enzyme synthesis takes place after irradiation. FDPase-activity is only slightly increased 11 days post-irradiation in fed mice and from 11 to 17 days after irradiation in mice starved for 24 hours. The activity of these two enzymes seems to confirm the assumption that glycolysis is not diminished after whole-body x-irradiation. (auth)

31011 THE RELATION BETWEEN BIOCHEMICAL CHANGE AND MORTALITY AFTER WHOLE-BODY IRRADIATION OF MICE. Streffer, Christian (Univ., Freiburg i. B.). Int. J. Radiat. Biol., 12: 487-96(Oct. 12, 1967). (In German).

The enzymatic activities of kynureninase and 5-hydroxytryptophan decarboxylase were investigated in the liver tissue of whole-body x-irradiated mice. Some days after irradiation a decrease of activity was observed with radiation doses higher than 500 R. This effect increased with doses up to 700 R. There was a pronounced correlation between the observed biochemical changes and the survival rate of the animals with respect to radiation dose and time. Both reactions after irradiation were influenced in the same way by the prophylactic application of 5-hydroxytryptamine. The relation between the biochemical systems and radiation sickness and the possibility of using these biochemical changes for the diagnosis of radiation damage are discussed. (auth)

31012 THE COMBINED EFFECT OF INFLUENZA VIRUS AND X RAYS ON THE METABOLISM OF NUCLEIC ACIDS IN MOUSE LUNG CELLS. Sklyanskaya, E. I.; Peterson, O. P.; Sulimov, A. A. (Ivanovskii Inst. of Virology, Moscow). Acta Virol. (Prague), 11: 189-9(May 1967).

Inbred (BALB/c) mice and randomly bred mice weighing 8 to 10 g were x irradiated with a sublethal dose of 300 R. From one to six days after irradiation the mice were infected intranasally with 10,000 LD_{50} of A type PR8 influenza virus per mouse. The control group of mice was intranasally given normal allantoic fluid. Comparative studies on the synthesis of nucleic acids in lung cells from irradiated and nonirradiated mice were performed at various intervals after infection with the virus. The multiplication of influenza virus in mouse lung cells induced two peaks in RNA synthesis, the first appearing 1 hr and the second 5 hr after infection. Prior irradiation of mice with sublethal doses of x rays reduced the height of both peaks, but predominantly the earlier one. Deoxyribonucleic acid synthesis in lung cells of irradiated or nonirradiated mice was not changed by the multiplication of influenza virus in these cells. (BBB)

31013 USE OF CONTINUOUS CULTURES FOR ESTIMATING STRONTIUM SORPTION BY CHLORELLA PYRENOIDOSA. Austin, John H. (Univ. of Illinois, Urbana); Klett, Carol A.; Kaufman, Warren J. Int. J. Oceanol. Limnol., 1: 1-27(Jan. 1967).

Chlorella cultures were developed under steady-state conditions with Ca and Mg concentrations comparable to those found in natural waters. The steady-state concentration of Sr (^{89}Sr activity) on the cells of C. pyrenoidosa depended on the ionic composition of the substrate. It was dependent not only on the concentration of the chemically similar element Ca, but also on the Mg concentration. At Mg concentrations above several hundred milligrams per liter the Sr and Ca distribution coefficients (the ratio of the sorbable ion in the solid and liquid phases) remained relatively constant. In waters containing considerable hardness or salinity it was then possible to estimate the Sr sorption by C. pyrenoidosa based on the Mg concentration of the water. At Mg concentrations below 100 mg/l, as found in many fresh waters, the Sr and Ca distribution coefficients varied with both Ca and Mg concentrations. In fresh waters it was then necessary to consider both Mg and Ca concentrations in estimating Sr sorption. Chlorella demonstrated a discrimination against Sr similar to that shown by other organisms at higher trophic levels. This discrimination could be expressed by K_{Ca}^{Sr}, which is the ratio of the Sr-to-Ca distribution coefficients. The value of K_{Ca}^{Sr} remained relatively constant over a wide range of Mg concentrations and averaged 0.58; a coefficient less than unity indicating discrimination against Sr, i.e., a favorable selectivity for Ca. The sorption of Sr by Chlorella varied considerably during various phases of the growth cycle. Thus, in natural aquatic systems where environmental conditions varied considerably with time, estimation of Sr sorption would be difficult; whereas in saline waters, with relatively constant environmental conditions, prediction of Sr sorption could be made with much more certainty. (BBB)

31014 X-IRRADIATION EFFECTS ON PROTEIN SYNTHESIS AND SYNTHESIS OF MESSENGER RIBONUCLEIC ACID FROM PEANUT COTYLEDONS. van Huystee, R. B.; Jachymczyk, W.; Tester, C. F.; Cherry, J. H. (Purdue Univ., Lafayette, Ind.). J. Biol. Chem., 243: 2315-20(May 10, 1968).

Exposure of peanut seed to 500 kR of x rays followed by 6 weeks of storage before planting resulted in a severe reduction of ^{14}C-amino acid incorporation by the ribosomal material. Ribosomes from irradiated tissue were just as effective as those from control tissue in amino acid incorporation directed by exogenous messenger RNA and polyuridylic acid. Polyribosomes were nearly absent from the ribosomal material obtained from irradiated tissue, and the synthesis of RNA and protein in vivo was much less than that for control cotyledons. The 105,000 × g supernatant from irradiated tissue was superior to the control supernatant when control ribosomes were used, but gave the same activity with ribosomes from irradiated tissue. Assay of leucyl and phenylalanyl transfer RNA synthetases showed that x-irradiation does not affect their activities. The supernatant fraction from irradiated tissue contains, however, only one-third as much ribonuclease activity as that of the control. The high level of RNAse activity in the control 105,000 × g supernatant possibly leads to degradation of the template and ribosomal RNAs, thereby reducing amino acid incorporation. Other experiments showed that mRNA, purified by methylated albumin Kieselguhr column chromatography from irradiated tissue, hybridized with control DNA about 20% as well as that from control tissue. It is concluded from our results that x-irradiation reduces the capacity of cells to produce biologically functional mRNA. (auth)

Ecology

Refer also to abstract 31076.

31015 DEPTH, DIEL, SEASONAL, AND GEOGRAPHIC VARIATIONS IN ^{65}Zn OF MIDWATER ANIMALS OF OREGON. Pearcy, William G.; Osterberg, Charles L. (Oregon State Univ., Corvallis). Int. J. Oceanol. Limnol., 1: 103-16(Apr. 1967).

The oceanic community of macroplankton and micronekton was sampled by midwater trawling at one station off Oregon during a two-year period to provide data on seasonal, bathymetric, and diel variations of incorporated ^{65}Zn. Pronounced seasonal variations, with summer maxima related to the seasonal occurrence of Columbia River plume waters off Oregon, were found in the ^{65}Zn content per gram of biomass of animals collected from the upper 150 m. These variations were less distinct in animals from 150 to 500 m, and no seasonal variations were apparent in samples from 500 to 1000 m. Although ^{65}Zn activities of animals collected at all depths during the winter were comparatively low, they were higher than in collections made at other stations farther offshore. This indicated that even in the winter most of the ^{65}Zn radioactivity originated from the Columbia River rather than fallout, and that some Columbia River water and its associated ^{65}Zn is retained off Oregon throughout the year. Zinc-65 per gram of sample was notably higher at night than during the day for animals collected in the upper 150 m in the summer. Therefore, vertical migrants may accumulate more radioisotopes on a wet weight basis than non-migratory, epipelagic animals. Diel changes in the ^{65}Zn associated with the captured animals were calculated for each depth stratum, but accurate estimates of vertical movements of radionuclides were not possible because of the avoidance behavior of small nektonic animals. Nighttime collections consistently contained more biomass and ^{65}Zn in the 0 to 1000 m water column than daytime samples. Nevertheless, a first approximation of the vertical movement of radiozinc suggested that about 40% of the ^{65}Zn incorporated in the animals sampled in the 0 to 1000 m water column moves twice daily through the base of the permanent halocline at 150 m. Thus, vertically migrating animals may play a major role in the movement of certain radioisotopes, or other materials, through density gradients in open ocean. (auth)

31016 EFFECTS OF CHRONIC GAMMA IRRADIATION ON LICHEN COMMUNITIES OF A FOREST. Woodwell, G. M.; Gannutz, T. P. (Brookhaven National Lab., Upton, N. Y.). Amer. J. Bot., 54: 1210-15(Nov.-Dec. 1967).

A homogeneous oak-pine forest characteristic of glacial outwash sands in central Long Island was γ irradiated, the principal trees being Quercus alba, Pinus rigida, and Q. coccinea. Shrub cover was Vaccinium-Gaylussacia synusia. The survey described was completed 32 months after the start of the experiment, at which time there was a gradient of damage to the higher-plant vegetation, from mortality of all indigenous species at exposures above about 300 R/day (at 15 m from the source) to minor effects on growth and reproduction at exposures below 1 R/day. Populations of corticolous and terrestrial lichens were reduced in approximate proportion to the rate of irradiation. Decline in species diversity was linearly related to logarithmic increases in daily radiation exposure. While a daily exposure of 2700 R/day was estimated to have reduced diversity to 50% in the first year, a linear extrapolation of diversity, coefficient of community and similarity curves to zero suggested that certain lichens would survive three-yr exposure at daily rates of 5000 to 10,000 R, possibly more. There was an apparent threshold at 300 R/day for radiation effects on the composition of lichen communities; changes in relative density occurred at lower exposures. The crustose forms were more resistant than foliose or fruticose forms, confirming that the most radioresistant higher plants are of short stature. (BBB)

Genetics and Cytogenetics

Refer also to abstracts 30792, 30953, 31109, 31211, 31240, 31298, and 31299.

31017 (BNL-10549) PROTEIN AND ENZYME VARIATION IN INDUCED MUTANTS OF TOBACCO. Bhatia, C. R.; Hart, G. E.; Smith, H. H. (Brookhaven National Lab., Upton, N. Y.). [1966]. Contract AT(30-2)-Gen-16. 17p. Dep. CFSTI.

Altered proteins and enzymes were demonstrated to occur in β-radiation-induced mutant lines of a higher plant. Acrylamide gel electrophoresis was used to detect electrophoretic variants among selections for plant height in the eighth inbred generation derived from irradiated seeds and unirradiated controls of the self-pollinating species Nicotiana tabacum. Gels prepared with extracts of comparable leaf material of three tall and three short selections from irradiated stock, as well as a tall and a short control selection, were stained for proteins with Amido Black and for esterases, peroxidases and leucine amino-peptidase. No variation in protein and enzyme patterns was observed in the tall and short control lines, or in two of the tall selections from the irradiated lots. All other mutant lines were different from the parent lines and from each other. Certain protein and enzyme bands were missing in the mutant lines. Marked changes in the pattern of peroxidases were observed in short selections. One of the mutant lines showed a new isozyme for LAP. (auth)

31018 (NP-17337) EFECTO DE LA RADIACION IONIZANTE Y DE LA ACTINOMICINA SOBRE LA NO DISYUNCION DE LOS CROMOSOMAS DE DROSOPHILA MELANOGASTER. (Effect of Ionizing Radiation and Actinomycin on the Non-disjunction of Chromosomes of Drosophila Melanogaster). Rodriguez Arnaiz, Rosario (Universidad Nacional Autonoma de Mexico, Mexico City. Facultad de Ciencias). 1967. 62p. (In Spanish). Dep. Thesis.

The effect of the antibiotic actinomycin on the spontaneous and x-ray induced non-disjunction process in the sex chromosomes of Drosophila melanogaster females was investigated. The experimental results show that in the days following fecundation there is a natural progressive decrease in the number of offspring each day. The major decrease is between the seventh and tenth days. Radiation induces sterility in the individuals born between the seventh and tenth day, and increases the frequency of non-disjunction. In the males the frequency of the loss of the X chromosome is greater than in the non-disjunction females. No simple explanation could be given for the dose-effect relation for non-disjunction. A much greater sterility is produced by the use of actinomycin than that produced by x radiation. Increase of the actinomycin dose decreases the frequency of non-disjunction. (J.S.R.)

31019 OBSERVATIONS ON THE MEIOTIC CHROMOSOMES IN THE NORMAL AND X-IRRADIATED GALLUS DOMESTICUS. Oprescu, St.; Constantinescu, Olga (Traian Savulescu Biological Inst., Rumania). Stud. Cercet. Biol., Ser. Zool., 19: 67-70(1967). (In Rumanian).

In view of the lack of data on the chromosomes of birds, the meiosis of hens was examined, comparing the meiotic chromosomes of normal birds with those of birds exposed to various rates of x radiation, in order to clarify the action of radiation on various stages of division. Twenty one-year old Rhode Island cocks were exposed to whole-body x irradiation of 200, 400, and 800 R. A 0.02% colchicine solution was injected intraperitoneally at a rate of 1 ml per 50 g of body rate two hours before sacrificing the birds, 24 hours after irradiation. The chromosome dispersion was determined by examining a preparation made from testicle fragments. It was found that 39 bivalent chromosomes were formed during diakinesis; the 6 macrobivalent and the largest microbivalent ones exhibited a chromomeric structure, with centralized centromeres. Irradiation of the cocks resulted in various cytogenetic modifications which increased with a total dose. The radiation inhibited meiotic division at a dose of 400 R and especially at 800 R, indicating increasing necrosis of the cell population. (TTT)

31020 COMPARISON OF THE SPECIFIC EFFECTS OF ULTRAVIOLET AND X RAYS ON MUTABILITY OF YEAST. Inge-Vechtomov, S. G.; Kozin, S. A. Issled. Genet., 2: 77-85(1964). (In Russian).

Red adenineless mutants were induced in a haploid strain of Saccharomyces cerevisiae by uv and x rays. About 180 such mutants proved to be distributed between two loci designed as ad_1 and ad_2. The ad_2 locus was more sensitive to the mutagenic action of both kinds of radiation than the ad_1 locus. Leaky and nonleaky mutants were scored in both loci. In ad_1 locus alleles suppressible and nonsuppressible by the external dominant suppressor were considered. Gene specificity of uv and x rays effects was determined by the ratio ad_2 mutations/ad_1 mutations. The gene specificity of these two agents appeared to be the same. Intragenic specificity of the mutagens used was found to be the same too. The latter kind of specificity was determined by the ratio leaky mutations/nonleaky mutations both in the ad_1 and ad_2 locus and by the ratio suppressible mutations nonsuppressible mutations in the ad_1 locus. The cause of the different sensitivity to radiation of the loci considered is discussed. Two alternative reasons were proposed to explain the impossibility of distinguishing uv and x rays effects by observation of their mutagenic specificity: (1) indirect action of the mutagens used; (2) only one class of mutations, common for both mutagens, was scored (point mutations). (BBB)

31021 NONDISJUNCTION OF CHROMOSOMES PRODUCED BY X RAYS OF DIFFERENT WAVELENGTH AND INTENSITY. Tikhomirova, M. M. Issled. Genet., 2: 56-64(1964). (In Russian).

An experiment was designed to study the mechanism of nondisjunction of X chromosome by irradiation of Drosophila females with x rays produced at 50 to 200 kV. The nondisjunction of X-chromosome was detected by the frequent occurrence of XO males. The females were irradiated with a single dose (3000 R) using radiation of different wavelengths and intensity. To show the after-effect, an additional treatment by maintenance of the flies at 37°C for 8 hr was carried 1 hr after irradiation. Hard x rays (short wavelengths) seemed to be more effective (2.81 ± 0.163%), than soft (longer wavelengths) (1.84 ± 0.124% and 0.97 ± 0.128%). The after-effect of hard x rays (4.45 ± 0.379%) differed from that of soft x rays (1.76 ± 0.145% and 1.29 ± 0.161%). Soft x rays at a greater intensity appeared to be more effective (1.84 ± 0.124%), than those at a lower intensity (0.97 ± 1.128%); dose rates were 1932 and 100 R/min, respectively. The results suggest that x rays of different quality produce different types of chromosomal breaks, which play a part in the mechanism of chromosomal nondisjunction. (BBB)

31022 HYDROXYUREA: EFFECT ON VICIA CHROMOSOMES PREVIOUSLY EXPOSED TO X-RAYS OR TO RADIOMIMETIC CHEMICALS. Kihlman, B. A.; Hartley, Beryl (Univ. of Uppsala). Exp. Cell Res., 48: 629-34(Dec. 1967).

Roots of Vicia faba were x-irradiated and treated with the radiomimetic chemicals, streptonigrin, phleomycin, 8-ethoxycaffeine, maleic hydrazide, and mechlorethamine hydrochloride or nitrogen mustard. The inhibitors of deoxyribonucleotide synthesis used in the experiment were arabinosyl-adenine, 2-deoxyadenosine, 5-fluorodeoxyuridine, and hydroxyurea. In all experiments the seedlings were treated with 0.05% colchicine the last 2½ hr before fixation. A table is presented to show the types and frequencies of chromosome aberrations obtained at various times after treatment with x rays alone and in combination with hydroxyurea. Another table shows types and frequencies of chromosome aberrations obtained after treatments with mechlorethamine hydrochloride, maleic hydrazide, and 8-ethoxycaffeine alone and in combination with hydroxyurea in colchicine. Results of experiments in which hydroxyurea was combined with x rays showed that the drastic increase of gaps and breaks was obtained only when hydroxyurea was given during the last 5 hr before fixation and that within the same mitotic cycle the time interval between irradiation and hydroxyurea treatment appeared to be of no consequence. When hydroxyurea was given after treatment with radiomimetic substances, no effect was observed with 8-ethoxycaffeine or with phleomycin. However, when hydroxyurea was given as posttreatment to streptonigrin, maleic hydrazide, or nitrogen mustard, the increase of the number of gaps and chromatid breaks was just as great as that observed in the x ray experiments. (H.L.W.)

31023 INDUCED AND SPONTANEOUS MUTATIONS IN DERMATOPHYTES. Hejtmanek, H. (Palacky Univ., Olomouc, Czech.). Z. Allg. Mikrobiol., 7: 279-81(1967). (In German).

A morphogenetic rosa mutant of Microsporum gypseum was obtained by repeated selection following uv irradiation of ascospores with a 51.2 mW/cm² lamp. The mutant consisted of numerous, easily fragmented, smooth-walled macroconidia. Their diameter ranged from 7 to 13 mμ, and the mycelia produced from them reached a length of more than 80 mμ. Cultures of the uv-induced mutant were sexually compatible with the initial culture of N. incurvata. In contrast to naturally occurring mutants reported previously, which were not induced by uv irradiation, the kleistothezia in this uv-induced mutant did not mature completely. Complete growth inhibition was obtained with a 2.5 μg/ml griseofulvin solution. Growth in vitro on hairs was characterized by formation of multiple perforating canalicules. Following infection of guinea pig skin the mutant could be recovered and recultured. Apparently, this in vitro isolated uv mutant also occurred spontaneously in natural populations of the saprophytic phase of the parasite. (BBB)

31024 THE RESPIRATION DEFECT IN YEAST CELLS: A CRITICAL CONSIDERATION OF ITS CAUSES. I. INDUCTION AND REVERSIBILITY OF THE "PETITE" MUTATION. Kraepelin, Gunda (Technische Hochschule, Brunswick, Ger.). Z. Allg. Mikrobiol., 7: 287-325(1967). (In German).

A respiration defect of yeast, characterized by an extrachromosomal defect consisting of a more or less marked reduction in activity of a typical mitochondrial enzyme is discussed. After uv irradiation chromosomal defects within the complex cytochrome system were observed to accompany the plasmatic respiratory defect. The respiratory defect might be photoreversible after a time interval, unless a chromosomally caused respiratory defect, or segregational petite with a double mutation had been induced. A chromosomal respiration gene could control the inactivation/reactivation of the plasma factor, so that the photoreactivity could be independent of the generally toxic uv effect. The uv effect was analogous to the effects of acridine orange and the energy-dependent release of decomposition products of protein and nucleic acids into a medium. Apparently, uv irradiation did not initiate this process, but increased it. (BBB)

31025 FUNDAMENTAL STUDY ON THE EFFECT OF CARCINOSTATICA. Ando, Bunichi (Kumamoto Univ., Japan). Nippon Sanka Fujinka Gakkai Zasshi, 18: 481-90(June 1966). (In Japanese).

In order to investigate the effectiveness of carcinostatics in combination with radiotherapy, ^{32}P was administered to rats bearing ascites hepatoma (AHO13), after administration of carcinostatics and treatment with ^{60}Co γ irradiation. Phosphorus-32 incorporation into the DNA and RNA of tumor cells was then studied. The results obtained were as follows: Gamma irradiation strongly inhibited ^{32}P incorporation into DNA. The incorporation into RNA was slightly inhibited and was higher at 46 hours than at 23 hours after irradiation. Nitromin O strongly inhibited ^{32}P incorporation into DNA, the extent of inhibition being proportional to its concentration. It also inhibited the incorporation of ^{32}P into RNA at high concentrations. When this treatment was used in combinations with γ irradiation, all animals died, exhibiting toxic symptoms. Endoxan strongly inhibited ^{32}P incorporation into DNA, the extent of inhibition being proportional to its concentration. It also inhibited the incorporation of ^{32}P into RNA. In the treatment combined with γ irradiation, ^{32}P incorporation into DNA and RNA was high, compared with that in Endoxan treatment alone. Mitomycin C strongly inhibited ^{32}P incorporation into DNA; the extent of inhibition was highest at intermediate concentrations. The incorporation of ^{32}P into RNA was also inhibited at intermediate concentrations, but was promoted at high and low concentrations. This treatment in combination with γ irradiation, inhibited strongly ^{32}P incorporation into DNA and RNA, showing the high effectiveness of the combined treatment. Toyomycin inhibited ^{32}P incorporation into DNA, and strongly inhibited incorporations into RNA. This treatment in combination with γ irradiation appeared to be more effective. Methotrexate inhibited ^{32}P incorporation into DNA and RNA, but the effect of this treatment in combination with γ irradiation was not apparent. COPP inhibited only slightly ^{32}P incorporation into DNA and RNA. (auth)

31026 THE EFFECT OF X-IRRADIATION ON MALE MEIOSIS IN SCHISTOCERCA GREGARIA (FORSKAL). II. THE INDUCTION OF CHROMOSOME MUTATIONS. **Westerman, M. (Univ. of Birmingham, Eng.). Chromosoma, 24: 17-36(Apr. 1968).**

Symmetrical exchanges between non-homologous chromosomes were recovered following x irradiation of germ-line cells of Schistocerca gregaria at different developmental stages. No x-autosome exchangers were observed. It was found that the frequencies with which autosomes of the three size groups L, M and S participated in exchange agreed with the frequencies expected based on effective exchange lengths of polarized interphase chromosomes. All of the observed symmetrical exchanges were between euchromatic segments of the chromosomes and though many of the exchange points were close to the centromere, no exchanges were found with break points actually in the centric heterochromatin. None of the heterozygous symmetrical exchanges had an observable influence on the chiasma conditions of the cell. (auth)

31027 RADIOACTIVITY IN THE INDIVIDUAL: RECENT STUDIES ON THE GENETIC EFFECTS OF RADIATION IN MICE. **Russell, William L. (Oak Ridge National Lab., Tenn.). Pediatrics, 41: Suppl., 223-30(Jan. 1968).**

Work with Drosophila spermatozoa has shown that the mutation frequency induced by a given total dose of radiation is not affected by the dose rate. Experiments on the effects of dose rate in the mouse showed the contrary to be true for spermatogonia and oocytes (the reproductive cell stages important in human hazards), spreading the dose out gives a marked reduction in mutation frequency. Radiation-induced mutation frequency from x and γ rays in mouse spermatogonia was measured with dose rates ranging from 90 to 0.001 R/min. Mutation frequency at 9 R/min was significantly lower than that at 90 R/min. In oocytes the difference between the mutation frequencies at 90 and 0.8 R/min was similar to that observed in spermatogonia. Raising the dose rate above 90 R/min gave no noticeable increase in mutation frequency in mouse spermatogonia. In mouse spermatogonia, the distribution of mutations among the seven loci tested was not affected by dose rate, even though the distribution itself showed marked differences between loci. In other words, the relative frequencies of mutations at the seven loci are constant regardless of dose rate. This suggests that the mutations that fail to be repaired at low dose rates are not qualitatively different from those that are repaired. When the conditions (e.g., cell stage) were changed so that the proportions of qualitatively different types of mutation (e.g., deficiencies vs nondeficiencies) were affected, then the relative frequencies of mutations among the seven loci were also affected. This indicates that, since change in dose rate does not alter the relative frequencies of mutations among the loci, the nonrepaired mutations among the loci, the nonrepaired mutations occurring at low dose rates may be qualitatively like the repaired one, i.e., originally capable of repair. It was concluded that, although mutation frequency may be very low in females exposed to low dose rates, in males there is evidence against a threshold dose rate, and the irreducible minimum mutation frequency occurring even at lowest dose rates is appreciable, i.e., between $\frac{1}{3}$ and $\frac{1}{4}$ of the maximum frequency obtained at high dose rates. In estimating human genetic hazards it now appears that the risk from small doses of acute irradiation may, in females at least, be lower than had been estimated on the basis of large doses. (BBB)

31028 RADIOINDUCED MUTATIONS IN DERMATOPHYTES. II. COLOR MUTANTS AND MUTANTS WITH REDUCED GROWTH IN MICROSPORON GYPSEUM (BODIN) GUIART AND GRIGORAKI. **Hejtmanek, M.; Hejtmankova-Uhrova, Nora; Kunert, J.; Lenhart, K.; Vicikova, Libuse (Palacky Univ., Olomouc, Czech.). Mycopathol. Mycol. Appl., 34: 49-60(Jan. 19, 1968). (In German).**

Mutagenic effects of uv radiation are reported in experiments wherein LD_{99} doses of uv radiation were used to treat the ascospores from a cross of two virulent cultures of Microsporon gypseum. By repeated selection, 17 color mutants and mutants with decreased growth were isolated. These mutants were constant during 20 transfers on agar medium. Their morphology, growth rate on Sabouraud's medium, compatibility, virulence, sensitivity to griseofulvin in vitro, growth on hair in vitro, and perforation activity on hair are described in detail. Keratinolytic activity was preserved in all mutants. The other features observed were markedly different, they included aberrant production of chlamydospores, loss of ability to produce macroconidia, loss of virulence, increase in sensitivity to griseofulvin, loss of compatibility, and increased or decreased growth rate. Some cultures, by their faviform character, pigmentation, and micromorphology imitated cultures of other dermatophytes. (BBB)

31029 COMPARATIVE STUDIES ON THE AFTER-EFFECTS OF IRRADIATION ON THE NONDISJUNCTION OF CHROMOSOMES. **Tikhomirova, M. M.; Dubrova, S. E.; Janoosh, I. M. Issled. Genet., 2: 65-8(1964). (In Russian).**

A comparative study was made of the after-effects of irradiation on the nondisjunction of X chromosome in 2 lines, W^a and Canton-S of Drosophila. Adult females were irradiated with a 3000-R dose of x rays (200 kV, without filter). To study the after-effect, the females at 1 hr after irradiation were kept at 37°C for 8 hr. An after-effect of irradiation was found in both lines. In Canton-S the successive treatment with x rays and high temperature gave 5.62 ± 0.460% exceptional males, a value of which was significantly higher than the arithmetic sum of the exceptional males found after independent treatments with x rays (3.50 ± 0.192%) and high temperature (0.11 ± 0.034%). Analogous results were found in the line W^a. The corresponding values for exceptional males in this line were: 4.46 ± 0.398, 1.62 ± 0.131, and 0.09 ± 0.051%. This after-effect of irradiation was found to be much higher in the radiation-resistant line W^a than in Canton-S which is less radiation-resistant. (BBB)

31030 ESTIMATION OF CHROMOSOMAL BREAK FREQUENCIES AFTER OCCUPATION EXPOSURE TO IONIZING RADIATION. Nazif, K. M.; El Naggar, A. M. (High Inst. of Public Health, Alexandria, Egypt). J. Egypt. Public Health Ass., 41: 299-309(1966).

The radiation doses received by workers at the U.A.R. Atomic Energy Establishment during the year 1965 were studied, with an estimation of the frequencies of chromosomal breaks after a hypothetical 30-yr continuous occupation exposure at the 1965 dose rates. Chromosomal culture may be useful in determining the effect of acute radiation exposure on somatic cells. A value of 1 break/cell/100 R represents an average rate for the human cell, and the threshold for immediate somatic damage starts at or above 25 R, at which ~¼ of cells are affected by single breaks. Since most of the abnormal cells die and disappear, their frequency gradually diminishes and becomes more or less persistent at a figure higher than that which occurs normally. Acute exposure to about 50 R or chronic exposure to 300 R gradually accumulated through a lifetime would double the frequency of spontaneous aberration. Considering 300 R accumulated through a period of 30 years' work as a doubling dose, it was possible to get a rough estimate of the exposed frequencies of breaks after actual occupational exposure. Nine % of workers were estimated to receive a dose of 90 R over a period of 30 yr. In this group the expected frequency was 1.3%, a rise of 0.3% over the expected spontaneous rate. In 0.2% of workers with an estimated dose 225 R over 30 years the frequency was expected to be 1.7%, or 0.75% over the spontaneous rate. The remaining 90.8% of workers would show the normal spontaneous occurrence of 1 break/100 cells. In all 3 groups the radiation exposure was considered to be harmless from the somatic-cell injury point of view. The probability of death from leukemia in 30 years becomes 3.5/1000 in the 1st group, 6/1000 in the 2nd group, and 2/1000 or less in the rest of workers. The probability of death from spontaneous leukemia for an individual in the general population in a 30-yr period is 1.5/1000. (BBB)

31031 MUTATION IN THANATEPHORUS CUCUMERIS. Flentje, N. T.; Stretton, Helena M.; McKenzie, A. R. (Univ. of Adelaide). Aust. J. Biol. Sci., 20: 1173-80(Dec. 1967).

Mutants were induced by uv irradiation of large numbers of single basidiospores of T. cucumeris. A 4-min exposure (dose = 16,992 erg/mm²) resulted in 50% of the spores dying within 12 hr. However, 24 surviving spores developed into colonies showing variations from the parent in one or more characters relating to color, growth rate, density of growth, branching, extent of aerial growth, prevalence of sectors, curling of hyphal tips, zoning, septation, and regularity of growth. Of these mutants, 4 subsequently died, and 5 were unstable and reverted to wild type. Of those remaining, 4 (sparse, stumpy, fleecy, and curly) were selected. These fertile, homothallic, homokaryotic cultures were used to study the occurrence and significance of the mutants. Mutations in the crucifier stem-attacking isolate occurred spontaneously, as well as by uv irradiation. Six of the mutants showing stability in culture were compared with one another and with their parent culture. The mutants differed in cultural appearance, growth rate, general morphology, mean number of nuclei per cell, and pathogenicity to crucifer stems, but none could be induced to fruit. Comparison of their pathogenic reactions on radish stems suggests that a series of steps, each controlled by a different genetic factor, is involved in the invasion of stems by the fungus. In another isolate, which was nonpathogenic, no mutants were detected. The minimum lethal dose of uv irradiation for the spores of each isolate differed considerably. (BBB)

31032 CYTOGENETIC ANALYSIS OF LETHAL MUTATIONS INDUCED IN DIFFERENT STAGES OF SPERMATOGENESIS OF DROSOPHILA. Khashim-Akhmed, M. C. Vestn. Leningrad. Univ., Ser. Biol., 21: 85-93(1965). (In Russian).

Premeiotic stages of spermatogenesis of Drosophila melanogaster (D-18), after x irradiation at 2000-R doses showed a higher percentage of mutation when treated males were transferred to high temperature (365°C) for 8 hr as compared to those at 25°C. This phenomenon was not seen at the higher dose of 4000 R. The results indicate that the effect of high temperature on the x-ray-induced rate of point mutations in these stages may involve an enhancement of the mechanism of restitution which gives rise to interstitial micro-aberrations and lethals. High temperature led to an insignificantly higher rate of induced sex-linked lethals in 9 repetitions out of 10 in postmeiotic stages (sperms and spermatids). The difference in percentage of recessive lethals in sperm and spermatid stages was due mainly to higher induced chromosomal aberrations in the spermatid stage. Between post- and premeiotic stages there was a period of complete sterility, the duration of which was more than 2 days after 2000 R and more than 5 days after 4000 R. Complete sterility was absent during spermatogenetic stages of males irradiated with 550 and 700 R. (BBB)

31033 OBSERVATIONS ON THE TRANSFORMATION OF HUMAN AMNION CELL CULTURES BY SIMIAN VIRUS 40. Chang, R. Shihman; Sinskey, T. J. (Harvard School of Public Health, Boston). J. Nat. Cancer Inst., 40: 505-12(Mar. 1968).

Experiments were performed to evaluate the potential of human amnion cell cultures as a tool in the investigation of in vitro transformation of normal human cells. Simian virus 40 (SV40) was the transforming agent used. The amnion cultures were readily transformed by SV40, and the transformed foci were easily recognized. Study of environmental factors that may affect the process of transformation revealed the following positive findings: X irradiation, blocked cell transformation but not virus synthesis; hydrocortisone delayed the appearance of the transformed foci; some older cultures were more easily transformed than some younger cultures, although a linear relationship between the in vitro age of a culture and its susceptibility to transformation could not be demonstrated, and overcrowding in a culture also may delay the appearance of transformed foci. (auth)

31034 EVOLUTION OF FITNESS. III. IMPROVEMENT OF FITNESS IN IRRADIATED POPULATIONS OF DROSOPHILA SERRATA. Ayala, Francisco J. (Rockefeller Univ., New York). Proc. Nat. Acad. Sci. U. S., 58: 1919-23(Nov. 1967).

Genetic variability induced by irradiation augmented, after selection, the adaptedness of two populations of Drosophila serrata to a new environment. (auth)

31035 DEVELOPMENTAL EFFECTS OF X RAYS ON EMBRYOS OF DROSOPHILA MELANOGASTER. Hildreth, Philip E. (Univ. of California, Berkeley). Proc. Nat. Acad. Sci. U. S., 58: 1924-9(Nov. 1967). (UCRL-17720).

In Drosophila melanogaster the effect of the gene er (erupt eyes) is suppressed by the gene Su-er (suppressor of erupt); thus, Su-er/Su-er;er/er individuals have normal eyes. X irradiation causes inactivation of the suppressor effect. Embryos from one to fifteen hours old were irradiated with 1000 R of x rays to determine the earliest stage during which inactivation would result. Embryos six hours old are the youngest in which inactivation by x rays resulted in a significant increase in the expression of the extreme-erupt phenotype. Whether x rays cause inactivation in embryos younger than six hours is questionable. It is suggested that inactivation results, probably, if the embryos are in or beyond the stage of stomodaeal invagination when irradiated. Data on the frequencies of hatching and eclosion, after irradiation of the above embryonic stages, are presented. (auth)

31036 DOMINANT RADIATION EFFECTS IN MOUSE POPULATIONS. King, Jack Lester (Univ. of California, Berkeley). Genetics, 58: 625-31(Apr. 1968).

Male random bred mice were subjected to 545 R spermatogonial γ irradiation and random bred for four consecutive generations, followed by a fifth generation of mating without irradiation. Other groups were withdrawn from the experimental population and bred without irradiation, or were withdrawn from the unirradiated control population and subjected to one generation of irradiation. Litters born to irradiated fathers showed a decrease in size at weaning of between 4% and 5%, but litters in groups in which irradiation was relaxed for one or more generations showed only a small and insignificant increase in litter size. It was concluded that dominant lethals were induced, but that there were no other net dominant deleterious effects. (auth)

31037 X-RAY AND MEIOTIC FINE STRUCTURE MAPPING OF THE ADENINE-8 LOCUS IN SACCHAROMYCES CEREVISIAE. Esposito, Michael S. (Univ. of Washington, Seattle). Genetics, 58: 507-27(Apr. 1968).

To investigate the relation between the size of the ad-8 gene and its low spontaneous mutability, the size of the locus was estimated by two independent criteria of gene size: recombinational length and number of mutable sites. Two methods of mapping were employed to determine the recombinational length of the locus. A meiotic fine structure map was constructed using allelic recombination frequencies after meiosis as a measure of the distance between mutant sites and an x-ray map was constructed from x-ray induced allelic recombination rates of mitotically grown diploids. The length of the meiotic fine structure map was $1033^{+}/10^{5}$ asci and the length of the x-ray map was $4.64^{+}/10^{8}$ cells/R. The number of mutable sites at the ad-8 locus, based upon the frequency of crosses involving reverting mutants that failed to recombine was 32 ± 74. The size of the ad-8 gene in terms of meiotic map length and number of mutable sites was compared to that of ad-6 that yields five to ten times as many spontaneous mutants as ad-8. The results of this comparison indicated that the low spontaneous mutability of ad-8 could be explained only in part by the difference in the size of these loci. The distribution of putative missense mutations on the ad-8 fine structure map indicated that this discrepancy might be due to the failure to recover appreciable numbers of missense mutants from one half of the ad-8 gene. While both the x ray and meiotic mapping of ad-8 mutants generated the same sequence and distribution of sites with few exceptions, they differed in resolution and additivity. Meiotic allelic recombination frequencies involving closely linked mutants were more additive than those involving markers further apart. Both crosses, between markers close together and those more distant from one another, demonstrated a tendency toward map expansion, i.e., the recombination frequency of a pair of mutants usually exceeded the value expected by summing the adjacent intervals between them. In the x-ray mapping, however, crosses involving closely linked mutants demonstrated a greater departure from additivity than those involving more distantly separated sites. The latter crosses could be divided into two classes. Those in which the expected value was less than $3.0^+/10^8$ cells/R showed a tendency toward map expansion. Those in which the expected value was greater than $3.0^+/10^8$ cells/R showed a tendency toward map contraction, i.e., the value observed was less than the value expected by summing adjacent intervals. (auth)

31038 RECOMBINATION IN REGIONS ADJACENT TO DELETIONS IN THE X CHROMOSOME OF DROSOPHILA MELANOGASTER. Lefevre, G. Jr.; Moore, L. B. (San Fernando Valley State Coll., Northridge, Calif.). Genetics, 58: 557-71(Apr. 1968).

Recombination frequencies were determined in regions adjacent to radioinduced X-chromosomal deletions in *Drosophila melanogaster*, both in the heterozygous and the homozygous condition. In heterozygous condition, two separate deletions lying within a region marked by yellow (0.0) and ruby (7.5) produced a striking reduction as compared with values obtained in control experiments with structurally normal chromosomes. One deficiency in the homozygous condition, provided with a duplication to prevent lethality, exhibited significantly more recombination in the marked interval than did its heterozygous counterpart. Results from the experiment with the homozygous deficiency were used to provide an accurate estimate of the genetic extent of the deleted region. The observed value closely corresponded with the expectation derived from a combined genetic-cytological unit of measurement, crossover frequency per salivary chromosome band, calculated from existing cytogenetic data. Tests of recombination in homozygous deficient females required the introduction of an insertional translocation to permit the survival of the females. Accordingly, the possible interchromosomal effects of three different insertional translocations on recombination in both deficient and structurally normal chromosomes were tested. No interchromosomal effects were shown to stem from their presence. However, a decrease in recombination was obtained in one homologous region of structurally normal chromosomes in the presence of the longest duplication tested, a finding consistent with the theory of competitive pairing. None of the inserted fragments affected recombination in a nonhomologous region of structurally normal chromosomes. (auth)

31039 SOMATIC MUTATIONAL TRANSIENTS: RESPONSE TO ACUTE GAMMA IRRADIATION BY TWO GENES IN A CLONE OF NICOTIANA. Sand, Seaward A.; Smith, Harold H. (Roswell Park Memorial Inst., New York. Brookhaven National Lab., Upton, N. Y.). Genetics, 58: 607-24(Apr. 1968).

The somatic effects of acute γ irradiation on a mutable allele of the *V* gene and on the stable *R* gene (both of which affect flower color in a clone of Nicotiana) were studied. The transient somatic responses after irradiation of the growing plants permitted refinement of a cell-generation model. Both genes were hypersensitive at low total doses. The mutation rate of the *V* gene system was about 3.5×10^{-5}/cell/R at 15R but decreased to $1/8$ of this at a dose of 180R. The mutation rate of the *R* gene decreased from 0.087×10^{-5}/cell/R at 15R to $1/5$ of this at 180R. The dose-response curves of the two genes differed from each other in shape as well as magnitude. (M.M.B.)

31040 HERSTEL VAN STRALINGSSCHADE IN ESCHERICHIA COLI. (Restoration of Radiation Damage in Escherichia Coli). Van De Putte, Pieter. Leiden, Univ. of Leiden, 1967. 98p. Thesis.

Repair of the damaging effects of uv or x radiation on the DNA of *Escherichia coli* was studied. The repair processes involved could be blocked by mutations; the resulting mutants were more sensitive to irradiation than the wild type. Five phenotypic classes of mutants are described; most of these mutants lacked the phage-type reactivating property. To obtain information on cell division, thermosensitive mutants were isolated and used. Some of the mutations were mapped; these are described. (84 references). (B.S.L.)

31041 GEMINI XI S-4 SPACEFLIGHT-RADIATION INTERACTION EXPERIMENT: THE HUMAN BLOOD EXPERIMENT. Bender, M. A.; Gooch, P. C.; Kondon, S. (Oak Ridge National Lab., Tenn.). Radiat. Res., 34: 228-38(1968).

The hypothesis that a radiobiological synergism existed between ionizing radiation and some other parameter associated with spaceflight was tested using both single- and multiple-break chromosome aberrations as biological end points. The Gemini XI manned spaceflight experiment results, like those of Gemini III, failed to show any increase in multiple-break aberration yields when the cells were irradiated during flight. Unlike the Gemini III results, however, the Gemini XI results showed no significant increase in the yields of single-break aberrations induced by in-flight irradiation. It was concluded that the significant difference seen in the Gemini III experiment resulted from random sampling error and that the postulated synergism was not demonstrable for either class of human chromosome aberrations. (A.W.B.)

31042 INDUCED MUTATION IN UV-SENSITIVE MUTANTS OF ASPERGILLUS NIDULANS AND NEUROSPORA CRASSA. Chang, Lung-ting; Lennox, J. E.; Tuveson, R. W. (Univ. of Chicago). Mutat. Res., 5: 217-24(Mar.-Apr. 1968).

Fewer adenine-independent mutants were induced by uv in a uv-sensitive mutant (uvs-I) of *Aspergillus nidulans* whether the comparison was made on the basis of equivalent dose or survival. Methionine-independent strains were induced with greater frequency in the same uv-sensitive strain (uvs-I) only at higher doses of uv and lower levels of survival. The induction of mutations to acriflavine or caffeine resistance was sharply restricted whether the comparison was made on the basis of equivalent dose or survival in a uv-sensitive mutant of *Neurospora crassa* (uvs-I). In addition to mutability, the uv-sensitive mutants in both species affect ascus development. It is suggested that reported effects of mutations conferring uv sensitivity on induced mitotic recombination may reflect altered mutability. (auth)

31043 LOW pH OF IRRADIATED SUCROSE IN INDUCTION OF CHROMOSOME ABERRATIONS. Bradley, M. V.; Hall, L. L.; Trebilcock, S. J. (Univ. of California, Davis). Nature (London), 217: 1182-3(Mar. 23, 1968).

A study is described on damage to chromosomes in the root tip of *Vicia faba* caused by treatment with irradiated sucrose solutions, in connection with reports on the possible deleterious biological effects of consuming irradiated sugars, or foods containing them. An influence of pH on the extent of chromosome aberration was noted. The root tips were treated with 2% sucrose solutions irradiated with 2 MR ^{60}Co gamma radiation at 5.5 kR/min. Experimental details are given. It was observed that the pH of the solutions changed during treatment, presumably as a result of root metabolism; for this reason the mean of readings taken before and after treatment was used in plotting curves. It was found that at pH 4.6 to 7.2 no more chromosome aberration was caused by irradiated solutions than by unirradiated control solutions. Below pH 4.6, however, percentages of abnormal anaphases in root tips exposed to either control or irradiated solutions increased with decreasing pH, the degree of increase being higher in irradiated solutions. The maximum percentage (32.5%) of abnormal anaphases attributable to irradiated sucrose occurred at pH 3.5. Increased duration of treatment, up to 24 hr, at pH 6.5, caused no differences in response to irradiated sucrose. The same types and percentages of aberrations appeared after treatment with irradiated and control solutions. The evidence points to low pH alone as the cause of mutagenic effects. The strong buffering in irradiated sucrose solutions may account for the higher incidence of abnormal anaphases from exposure to irradiated solutions. (UK)

31044 MUTAGENIC STUDIES WITH ^{45}Ca AND ^{89}Sr IN MAIZE AND LILIUM. Steffensen, Dale M. (Univ. of Illinois, Urbana). Mutat. Res., 5: 237-42(Mar.-Apr. 1968).

The frequency of losses of chromosome markers, attributable to ^{45}Ca or to ^{89}Sr, was found to be nil in the endosperm of maize that develop from pollen labeled at the isotope levels employed and in the population sizes examined. For comparison, maize pollen was also labeled with radioactive sulfur or phosphorus, or treated with x rays. Dominant lethality was investigated in *Lilium longiflorum* using pollen labeled with ^{45}Ca, ^{32}P, and ^{35}S. The experimental design permits one to utilize the naturally phased development of lily pollen in relation to the periods of DNA replication. If ^{32}P was present prior to replication, dominant lethals were produced, as detected by failure of embryo or endosperm development. Dominant lethality was less evident with ^{45}Ca or ^{35}S, probably attributable to lower amounts of isotopic incorporation into pollen. In general, the degree of response depended on the amount of isotope incorporated into the pollen (sperm). Dominant lethality was no higher than in controls when the isotope was administered after both DNA replications were completed in maturing pollen. (auth)

31045 THE INFLUENCE OF DOSE AND GERM-CELL STAGE ON X-RAY-INDUCED CROSSOVERS IN MALE DROSOPHILA. Bateman, A. J. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Mutat. Res., 5: 243-57(Mar.-Apr. 1968).

Newly hatched Drosophila males heterozygous for b pr and vg were exposed to 1000 rad and mated daily to fresh b pr vg females. The first crossovers appeared on day 6 (1.5‰). On days 7, 8, and 9 there was a peak incidence of crossovers (between 6 and 10‰). We conclude that these were induced in spermatocytes. There was a decline in incidence over days 10 and 11, with increasing evidence of clustering, to day 12 (2‰) with maximum clustering. Evidence is presented for concluding that days 10 and 11 represent irradiated secondary spermatogonia and day 12 and later, stem cells. Crossovers induced in spermatocytes have lower fertility and viability than those induced in spermatogonia, but this effect is largely due to effects of irradiation on spermatocytes which have been induced independently of the crossover event. After 3000 rad the peak of crossing-over (3%) is obtained on days 10 and 11 (secondary spermatogonia). By studying the induction of crossovers in concurrent experiments at 1, 2, 4, and 6 krad and using different markers (dp b cn bw) we have confirmed that the sensitivity pattern is dose-dependent. The explanation for this appears to be that whereas the yield of crossovers in spermatocytes and stem cells is linearly dependent on dose, the induction of crossovers in determinate spermatogonia is proportional to the dose to the power of $^3/_2$. (auth)

31046 UV-INDUCED REVERSION TO PROTOTROPHY IN THREE STRAINS OF CHLAMYDOMONAS REINHARDI DIFFERING IN DARK REPAIR CAPACITY. **Davies, D. Roy; Levin, Suzanne (Atomic Energy Research Establishment, Harwell, Eng.). Mutat. Res., 5: 231-6(Mar.-Apr. 1968).**

The induction by uv radiation of mutations to prototrophy was compared in three strains of Chlamydomonas reinhardi differing in their capacity to repair lethal damage. One of the loci affecting dark-repair had a marked influence on mutation induction under dark conditions, in that the frequency was enhanced at low, but decreased at high doses. Photoreactivation eliminated the differences between the strains. The basic features of the data can be interpreted in terms of a model analogous to that proposed by Witkin for bacteria. It is suggested that mutations arise in this system during a process whereby cells attempt to by-pass residual damage left within the DNA. (auth)

31047 INDUCING PLANT MUTATIONS BY NEUTRON IRRADIATION. **Gerrard, Martha. Isotop. Radiat. Technol., 5: 313-14(Summer 1968).**

The minutes of two meetings on standardization of procedures for irradiating seeds to produce mutations are reviewed. (auth)

31048 RELATIONSHIP BETWEEN SPONTANEOUS AND RADIATION-INDUCED LOSS OF SPECIFIC MOLECULAR STRUCTURE. **Johnson, Horton A. (Brookhaven National Lab., Upton, N. Y.). Radiat. Res., 32: 663-70(1967).**

The energy distribution of a radiation field of discrete high-energy events can be compared with the Boltzmann distribution in regard to effectiveness in producing biomolecular transitions. This comparison provides an absolute relationship between the rates of radiation-induced and spontaneous biomolecular transitions. Such a relationship allows the calculation, on purely theoretical grounds, of the radiation dose rate that doubles the spontaneous rate of point mutations. (auth)

31049 ABNORMAL ANAPHASES IN REGENERATING MOUSE LIVERS. **Conger, Alan D.; Curtis, Howard J. (Temple Univ., Philadelphia. Brookhaven National Lab., Upton, New York). Radiat. Res., 33: 150-61(1968).**

The frequency of anaphase abnormalities (usually presented as bridges, bridges plus fragments, or percentage of normal anaphases) is widely used as a criterion of radiation damage in many materials. Here, the frequency of these three abnormal anaphase categories was studied in a material frequently used for this purpose, regenerating mouse liver, following fast neutron irradiation (50 to 800 rads). A previous study with the plants Tradescantia and barley showed that detected anaphase bridges increased with dose more or less linearly at first, to a maximum, and then actually declined at higher doses. Two different bridge-loss processes between metaphase and anaphase were shown to account quantitatively for this dose response. The results and conclusions were felt to be applicable to anaphase data in general, from any material. The same response was found in the mouse liver. The frequency of anaphase bridges per cell increased with dose to a maximum, then declined at larger doses. The percentage of normal (aberration-free) anaphases reflected this increasing-with-dose loss of bridges by showing an actual increase in normalcy at larger doses, after an initial decline to a minimum of normalcy. In addition, for the mouse liver cells, it is shown that only 40% or less of the fragments actually present at anaphase is detected. In the practical sense, the widely used criterion of abnormal anaphases is an inefficient but reasonable measurement of damage in the range of low dose and low level of effect; that is, the amount of effect is about proportional to the dose. For mouse livers, it is estimated herein that the observation of abnormal anaphases detects only about 40 to 50% or less (about 40% of fragments, 50% of bridges) of the aberrations actually present, up to a dose of about 200 rads of fast neutrons. At higher doses, as the exponential-with-dose disappearance of bridges becomes appreciable, abnormal anaphases become grossly incorrect, actually decreasing with dose. (auth)

31050 CHROMOSOME ABERRATIONS OBSERVED IN HUMAN BLOOD CELLS IRRADIATED WITH DIFFERENT DOSE RATES OF 35-MeV ELECTRONS. **Feremans, W. (Institut Bordet, Brussels. Univ., Brussels). Eur. J. Cancer, 3: 209-15(Aug. 1967). (In French).**

Human blood cells harvested in vitro were irradiated at the 55th hour with 35 MeV electrons. Five samples of cultures received 200 R at different dose rates of respectively 10, 50, 100, 250, and 450 R/min; 5 other samples were irradiated in the same conditions with 400 R. One hit chromosomal aberrations were not dose rate dependent whereas 2 hit aberrations were related to dose rate. (auth)

31051 RBE OF π^- BEAMS IN THE BRAGG PEAK REGION DETERMINED WITH POLYPLOIDY INDUCTION IN MAMMALIAN CELLS IRRADIATED IN VIVO. **Loughman, W. D.; Feola, J. M.; Raju, M. R.; Winchell, H. S. (Univ. of California, Berkeley). Radiat. Res., 34: 56-69(1968).**

The RBE of components of a π^--meson beam, contaminated with electrons and π^- decay products, was determined for polyploidy induction in a mammalian cell system in vivo. The RBE in the plateau region of this beam was 1 relative to cobalt-60 gamma rays, whereas in the Bragg peak region it was 2.15. For pion effects only in the peak region, RBE was 2.37; for star effects only, it was 3.64. On the basis of theory and preliminary observation, it is believed that RBE values for cell killing exceed the values found for polyploidy induction. It was concluded that the diminished oxygen effect and low ratio of surface dose to depth dose displayed by π^- beams having a Bragg peak region, coupled with the Bragg peak region's relatively high RBE, indicated that π^- beams may be useful in tumor radiotherapy. (auth)

31052 PRELIMINARY DATA ON RADIATION-INDUCED CHANGES IN DECORATIVE PLANTS. **Simon, Jozsef (National Committee for the Application of Isotopes, Hungary). Atomtech. Tajek., 10: 691-4(1967). (In Hungarian).**

In cooperation with the Chair of Decorative Plants of the Horticultural College, irradiation experiments were carried out with ^{60}Co sources to obtain mutants of certain vegetatively propagated plants, including Portulacaria afra, Aloe arborescence, Sedum stalili, Crassula portulacea, Crassula multicava, Briophyllum tubiflorum, Chrysanthemum, Gladiolus, and Tilia argentea. Doses of 1000, 2000, 3000, and 4000 R were used for the chrysanthemum cuttings; the last dose was found to be lethal for the roots. The other plants were exposed to doses up to 7000 and 8000 R. The results after the first year of experiments indicated that γ irradiation induces considerable mutations, some of which could be of economic importance. The optimum total dose for chrysanthemum appears to lie between 1000 and 2000 R; for xerophytic plants it is estimated to lie between 8 and 10 kR. Cytological, morphological, and breeding studies are in progress. (TTT)

31053 CHLOROPHYLL MUTATIONS AS AN INDICATION OF GENETIC PROTECTION AGAINST GAMMA RADIATION IN BARLEY. **Zosimovich, V. P.; Levenko, B. A. (Inst. of Botany, Kiev). Genetika, 4: No. 3, 104-10(Mar. 1968). (In Russian).**

The frequency of chlorophyll mutations in two spring barley varieties and a winter barley variety was studied. Barley seeds were soaked in solutions of thiourine, cysteine, and ferrous chloride and treated with γ rays. The soaking resulted in the decrease of frequency of chlorophyll mutations induced by γ rays. Varieties of spring barley behaved similarly, unlike the response of the winter barley variety. A difference between the varieties in the response to the same chemical was observed, which probably can be explained by the varietal specificity. (auth)

31054 ELIMINATION OF CHROMOSOMAL LESIONS IN THE CELLS OF THE RAT'S LIVER IN THE CASE OF FRACTIONAL X-RAY TREATMENT. **Ol'shevskaya, O. P.; Shapiro, I. M.; Yarmonenko, S. P. (Inst. for Work Hygiene and Occupational Diseases of the USSR Academy of Medical Sciences). Dokl. Akad. Nauk SSSR, 178: 226-9(Jan. 1, 1968). (In Russian).**

Chronic irradiation of rats for periods between two weeks and six months resulted in a continued decrease of cells exhibiting chromosome aberrations; this decrease depended on the duration of the tests when a single exposure was used. The correlation between the number of irradiations and the periods between the exposures was determined using fractional irradiation at high dose rates. Male white rats were x-irradiated in rotating cylindrical chambers; at each revolution the rats were exposed to a dose between 0.7 to 7 rad at a dose rate of 18 rad/minute. After 30 to 32 hours, the animals were killed and their liver cells were examined for chromosomal aberrations. The results failed to indicate any statistically important differences; thus neither the number of repeated exposures ranging from 0.7 to 7 rad, nor the period between them (one to 10 days) influenced the effect of fractional exposure. It was also found that at high dose rates, fractionation of the total dose of 70, 100, and 300 rad into 0.7 to 30 rad units reduced the overall effect with respect to the total dose. (TTT)

Health Physics and Safety

Refer also to abstracts 30667, 30737, 30764, 30792, 30868, 30873, 30911, 30935, 31015, 31101, 31124, 31126, 31135, 31145, 31164, 31175, 31178, 31194, 31203, 31228, 31241, 31268, 31616, and 31886.

31055 (A/AC.82/G/L–1188) UROVNI SODERZHANIYA GLOBAL'NOGO TSEZIYA-137 V ORGANIZME LYUDEI RAZLICHNYKH GRUPP KORENNOGO NASELENIYA NENETSKOGO NATSIONAL'NOGO OKRUGA V 1965 G. (Content Levels of Global ^{137}Cs in the Organisms of Members of Various Groups of the Indigenous Population of the Nenetz National Area in 1965). Moiseev, A. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1967. 10p. (In Russian). Dep.

By use of the portable one-channel γ spectrometer Sever in the winter of 1964–1965 and the autumn of 1965, the content of ^{137}Cs in the people of different groups of the native population of of the Nenetz region was measured. In the autumn of 1965 the highest level of ^{137}Cs was in shepherds (mean content was 8.7 ± 0.7 nCi/kg of wt, the range of the observed values from 3.8 to 12.0 nCi/kg of weight or 190 to 800 nCi for the whole body). This mean value of the Cs burden was 1.7 times less than in shepherds in the winter of 1964–1965. The content of ^{137}Cs in the body of men, women, and children was also measured. (tr-auth)

31056 (AD–648505) THE PRESENT STATUS OF CHEMICAL RESEARCH IN ATMOSPHERE PURIFICATION AND CONTROL ON NUCLEAR-POWERED SUBMARINES. Annual Progress Report No. 5, 1964. Alexander, A. L.; Piatt, V. R. (Naval Research Lab., Washington, D. C.). Jan. 11, 1967. 60p. (NRL–6491). CFSTI.

Research on the atmospheric habitability of nuclear-powered submarines is reported. Considerable progress was made in the major efforts of developing improved methods of sampling and analysis of atmospheres, but shipboard analytical equipment continues to be of marginal quality. Problems associated with volatile chlorinated hydrocarbons in closed environments led to their complete ban. Other topics covered include: further studies on algae as a source of oxygen (now discounted for nuclear submarines due to the excessive power requirements of the necessary light source), fire-retardant and nontoxic paints for necessary application during submergence, and a survey of oxygen sources based on a recurring need to improve the safety, reliability and logistics of the high-pressure electrolytic oxygen generator now on all FBM submarines. (auth) (TAB)

31057 (AE–312) REPORT ON THE PERSONNEL DOSIMETRY AT AB ATOMENERGI DURING 1966. Carlsson, J.; Wahlberg, T. (Aktiebolaget Atomenergi, Stockholm (Sweden)). Mar. 1968. 9p. Dep.

Results of personnel dosimetry at AB Atomenergi during 1966 are reported. The external total body dose for all employees (quarterly doses ≤100 mrem are not reported) corresponded to 114 manrem. The doses did not exceed the limits recommended by ICRP. However, there was an increase in the exposures, as well as in the number of exposed persons over the last years. Twenty-six thousand and three hundred gamma films and 4,300 neutron films were evaluated; 1,632 urine analyses and 809 measurements of body activity were made. (auth)

31058 (BNWL-SA–1511) INTERNAL RADIATION DOSE MANAGEMENT ASPECTS OF ACCIDENTAL NUCLEAR EXPLOSIONS. Andersen, B. V.; Bramson, P. E.; Larson, H. V. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 8, 1968. Contract AT(45-1)-1830. 14p. (CONF-680507-1). Dep. CFSTI.

From Conference on Radiological Protection of the Public in Nuclear Mass Disasters, Interlaken, Switzerland.

The measurement, evaluation, and management of internal exposure received from inhaled or ingested nuclear debris are discussed. Particular emphasis is placed on instrumentation for rapid sorting of contaminated persons and methods for minimizing deposition by accelerated removal of the offending debris from the body. The use of sequestering agents (chelates), laxatives, and isotope dilution are the methods discussed. (auth) (TSS)

31059 (CEA-R–3381) TENEUR EN ^{90}Sr D'OS HUMAINS PRELEVES DE 1962 A 1966. (^{90}Sr Content of Human Bones Collected from 1962 to 1966). Jeanmaire, Lucien (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Nov. 1967. 31p. (In French). Dep.

Results of ^{90}Sr determination made on human bones collected in the Paris region from 1962 to 1966 are presented. The results are classified according to the year and the age-group in two tables and one figure which show the general evolution of the contamination during this period. (auth)

31060 (MLM–1460) CALCULATED DOSE RATES FOR ^{238}Pu DIOXIDE. Meyer, C. T.; Anderson, H. F.; Kahle, J. B. (Mound Lab., Miamisburg, Ohio). Aug. 15, 1967. Contract AT-33-1-GEN-53. 37p. Dep. CFSTI.

A computerized program was developed to determine the gamma dose rates from plutonium dioxide as a function of mass, density, distance from the material, and time elapsed after purification. The program gives the gamma dose rate from the bare material as well as the dose rate attenuated by components of a typical glove box. Literature values were selected for the gamma energies of the seven isotopes in the plutonium dioxide, their relative abundance, and the linear absorption coefficients in various shielding materials. A spherical source was assumed with corrections for self-absorption. The 17-keV x-ray component of ^{238}Pu contributes 99 and 93% of the total dose rate from bare and acrylic resin-shielded material, respectively, and practically zero percent of the dose rate from the iron and lead-shielded material. The ^{208}Tl component, however, contributes up to 20% of the total dose rate from the iron- and lead-shielded plutonium dioxide after 10 yr. A means for evaluating the neutron dose rate was also included. (auth)

31061 (NP–17201) NEKOTORYE ASPEKTY TKANEVOI DOZIMETRII RADIYA-226. (Some Aspects of Tissue Dosimetry of ^{226}Ra). Malykhin, V. M.; Shamov, V. P. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1967. 27p. (In Russian).

The dosimetry of ^{226}Ra presents a number of problems, since the irradiation dose to the bone occurs over a period of years, and the ^{226}Ra content in the organism at the moment of observation is extremely small compared to the amount entering the organism in the past. On assuming a natural regional ^{226}Ra content of 2×10^{-12} Ci and an average ^{226}Ra content of 7.5×10^{-11} Ci in the organism, it is possible to determine the accumulation, excretion and dosage of ^{226}Ra during administration of a single dose to the body. Equations and nomograms are given for doses to the organism over extended periods of time. Measurements of the exhaled radon were more sensitive than alpha counting on ashed samples. The maximum allowable concentration of ^{226}Ra in air and water is given for different contact times. (TTT)

31062 (ORNL-TM–2149) DESCRIPTION OF FACILITY CONTAMINATION ALARM SYSTEM AND CONTAINMENT SYSTEM INSTALLED IN THE FISSION PRODUCTS DEVELOPMENT LABORATORY, BUILDING 3517. Russell, J. A.; Holladay, J. H.; Knowles, D. J. (Oak Ridge National Lab., Tenn.). Mar. 4, 1968. Contract W-7405-eng-26. 33p. Dep. CFSTI.

A Facility Contamination Alarm System was added to the existing radiation monitoring and containment alarm system in the Fission Products Development Laboratory, Building 3517. The instruments in these systems provide health physics monitoring information and actuate local alarms and remote alarms on two central monitoring panels when abnormal radiation or contamination conditions occur. The facility is continuously monitored for gamma radioactivity by 19 monitrons. Ten high-volume, beta-gamma air monitors are part of the Containment System, and four beta-gamma constant air monitors are used in the Facility Contamination Alarm System. Operating personnel are first given warning when a caution level of 7.5 mr/hr is detected by a monitron or 1000 counts/min is detected by a model Q-2240 constant air monitor, and again when a high level of 4000 counts/min is detected by an air monitor (alarm levels for a model Q-2312 mobile air monitor are 2000 counts/min for caution level and 10,000 counts/min for high level). The building evacuation alarms operate automatically when two or more of the Facility Contamination Alarm System air monitors detect a high level of air contamination. The building is put into containment by combinations of alarm signals from the high-volume air monitoring system. These two systems are essentially independent except for a dual alarm indication for four constant air monitors. (auth)

31063 LARGE SCALE FIXED BED ION-EXCHANGE SYSTEM FOR REMOVING ^{131}I AND ^{90}Sr FROM MILK. Marshall, R. O. (Producers Creamery Co., Springfield, Mo.); Sparling, E. M.; Heinemann, B.; Bales, R. E. J. Dairy Sci., 51: 673-8(May 1968).

A large scale fixed bed ion exchange system for removing ^{90}Sr and ^{131}I from fluid milk is described. In one abbreviated trial and three full-scale trials, 149,000 liters of milk were processed at flow rates averaging up to 8,600 liters/hour. Radionuclide removal efficiency averaged 98.9% for ^{131}I, 94.6% for ^{85}Sr, and 90.0% for ^{90}Sr. Although not an object of the study, it was found in one run that 66% of the environmental ^{137}Cs was also removed by the cation column. Some decrease in flavor score was noted, particularly in the first milk through the anion resin column. Bacterial studies indicated that a slight increase in psychrophil counts occurred during processing. Chemical and physical compositional changes in milk passed through the ^{90}Sr and ^{131}I combined ion exchange system were approximately the same as for milk passed through the ^{90}Sr system alone. (auth)

31064 MERCURY CONTENT OF WORLDWIDE SAMPLES OF WHEAT. Kim, Chong K.; Silverman, Joseph (Univ of Maryland, College Park). Trans. Amer. Nucl. Soc., 11: 54(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31065 DECONTAMINATION OF RADIOIODINE-CONTAINING BASIN WATER WITH RAPID FILTERING ARRANGEMENTS USING SILVER SALTS. Kremling, K.; Bernhardt, H.; Hartmann, H. (Technische Hochschule, Brunswick. Labor des Wahnbachtalsperrenverbandes, Siegburg, Ger.). Vom Wasser, 33: 82-130 (1966). (In German).

The effect of silver nitrate as a decontaminating agent for ^{131}I-containing basin water was investigated in a semi-industrial research filtration installation. Two sampling methods were developed. In the first method the radioactive iodide was precipitated as colloidal AgI with $AgNO_3$ and then flocculated with iron hydroxide in alkaline solution and filtered. The other method was based on the uptake of radioactive iodide on anion and isotope exchange processes on AgCl and AgI. The optimum conditions were determined for both sampling methods. The results showed that most economically favorable decontamination occurs when the filter operating in the exchange method is charged with AgCl. (J.S.R.)

31066 AUTORADIOGRAPHY OF SOME PLANT SAMPLES FROM THE LANDES DISTRICT TAKEN IN 1964. Genevois, Louis; Flavier, Henri (Faculte de Sciences, Bordeaux). Proces-Verb. Seances Soc. Sci. Phys. Natur. Bordeaux, 167-72 (1964-65). (In French).

Autoradiographs were made of leaves of Castanea and *Quercus robur*, of peat moss and of Pteris fronds contaminated by ^{144}Ce, ^{147}Pm, and ^{90}Sr from fallout. Specimens were collected in the Landes district of France during 1964. Ashed materials from the same samples yielded 6800 counts per min per g. (H.G.D.)

31067 NEW DEVELOPMENTS IN THERAPEUTIC DOSIMETRY. Holt, J. G.; Laughlin, J. S. (Memorial Hospital, New York). Trans. Amer. Nucl. Soc., 11: 398-400(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31068 DOSIMETRIC STUDIES FOR BORON CAPTURE THERAPY AT MITR. Ayyangar, K. M. M. S.; Reddy, A. R.; Brownell, G. L. (Massachusetts General Hospital, Boston). Trans. Amer. Nucl. Soc., 11: 59-60(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31069 BIOLOGICAL DOSE RATE FROM AN IMPLANTED ISOTOPE-POWERED CIRCULATORY ASSIST DEVICE. Greenborg, J.; Griffin, B. I. (McDonnell Douglas Corp., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 90-1(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31070 MEASUREMENT OF ^{32}P IN PLANT MATERIAL BY AUTORADIOGRAPHIC TECHNIQUE. Datta, N. P.; Shome, K. B. (Indian Agricultural Research Inst., Delhi). J. Indian Soc. Soil Sci., 13: 157-60(1965).

An autoradiographic technique is described for the quantitative assay of ^{32}P in plant material using a photoelectric colorimeter for opacity measurement of radiogram. The results obtained by this technique compared well with those determined by the standard procedure with a G. M. counter. The method offers an easy means of using isotope dilution technique. (Indian Sci. Abstr.)

31071 CALCULATION OF NEUTRON FLUENCE-TO-KERMA FACTORS FOR THE HUMAN BODY. Ritts, J. J.; Solomito, E.; Stevens, P. N. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 403-4(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31072 USE OF RADIOPHOTOLUMINESCENCE IN DOSIMETRY. Teyssier, Jean-Louis (Centre de Physique Atomique et Nucleaire, Toulouse). Radioprotection, 2: 33-54(1967). (In French).

The mechanism of radiophotoluminescence used for nuclear radiation dosimetry of alkali halides is reported. Investigations were carried out on: the properties of glasses used as dosimeters; linearity of response versus applied dose; dose cumulation; stability as a function of time; and energy dependence. Various uses of glasses and their response to neutrons were also examined. (auth)

31073 AGREEMENT BETWEEN THE INTERNATIONAL ATOMIC ENERGY AGENCY, THE GOVERNMENT OF JAPAN, AND THE GOVERNMENT OF THE UNITED KINGDOM OF GREAT BRITIAN AND NORTHERN IRELAND FOR THE APPLICATION OF AGENCY SAFEGUARDS IN RESPECT OF THE BILATERAL AGREEMENT BETWEEN THOSE GOVERNMENTS FOR COOPERATION IN THE PEACEFUL USES OF ATOMIC ENERGY, VIENNA, 26TH SEPTEMBER 1967. United Kingdom Government Treaty Series No. 3 (1968). London, Her Majesty's Stationery Cffice, 1968. 11p. 1s. 6d.

The Articles covered include: Article I. Use for peaceful purposes, Article II. Application of safeguards by the Agency, Article III. Agency Inspectors, Article IV. Finance, Article V. Settlement of disputes, Article VI. Agency safeguards system and definitions, and Article VII. Entry into force, amendment and duration. The inventory is specified. (UK)

31074 A FORMALISM FOR CALCULATION OF ABSORBED DOSE FROM RADIONUCLIDES. Loevinger, Robert (International Atomic Energy Agency, Vienna); Berman, Mones. Phys. Med. Biol., 13: 205-17(Apr. 1968).

Traditional methods of carrying out internal-dose calculations are not adequate for the detailed models now in existence, nor for the many types of radionuclides presently in use. A formalism for absorbed-dose calculation is presented which is applicabl to all radionuclides and all models. It is based on equations which are derived in general terms, independent of the properties of any single type of radiation. The development of the formalism starts with the concept of absorbed fraction, but a new concept, specific absorbed fraction (i.e., absorbed fraction per gramme), is shown to be more widely applicable. The proposed formalism, however, will increase the complexity of dose calculation only in circumstances where traditional methods oversimplify the concepts and distort the result. (auth)

31075 AN ASSESSMENT OF MONTE CARLO CALCULATIONS TO DETERMINE GAMMA RAY DOSE FROM INTERNAL EMITTERS. Ellett, W. H. (Royal Postgraduate Medical School, London); Brownell, G. L.; Reddy, A. R. Phys. Med. Biol., 13: 219-30(Apr. 1968).

A Monte Carlo model of γ-ray diffusion is presented with a discussion of its application to dosimetry problems. Two methods of using photon history data to calculate γ-ray dose are reviewed, involving summing the energy losses from individual events, or calculating the energy fluence. Approximations in the γ-ray history simulation model are analyzed and the relative importance of the various assumptions established. Studies of the spectra of scattered radiation show that results are not affected by use of a finite energy cut-off to terminate histories. The Klein–Nishina free electron approximation as a model for γ-ray scattering is shown to be an adequate approximation for the purposes of γ-ray dosimetry. (auth)

31076 ACCUMULATION OF FISSION PRODUCTS BY FRESHWATER FISH. Ruf, M. (Bavarian Biological Experimental Station, Munich). Bull. Office Int. Epizoot., 65: 707-13(May-June 1966).

Radioactivity in fish consists mainly of ^{137}Cs. Freshwater fish ^{137}Cs activities ranged in 1964 from 20 to 2000 $\mu\mu$Ci/kg wet wt. The contamination has increased from yr to yr, though the last nuclear weapon tests were stopped in the autumn of 1963. The ^{90}Sr activities found were far smaller and amount to between 20 and 120 $\mu\mu$Ci/kg wet wt. At present ^{137}Cs activities in fishmeat are between 34 and 3,230 $\mu\mu$Ci/kg, and ^{90}Sr activities in bones are between 28 and 1,240 $\mu\mu$Ci/kg wet wt. Greater quantities of ^{137}Cs were found as compared to ^{90}Sr in bones. The ^{90}Sr concentration in fishmeat was negligibly low as compared to the ^{137}Cs activity. The ^{137}Cs activity in gonads and other organs was much lower than in meat. The activities of ^{89}Sr, ^{54}Mn, ^{95}Zr, and ^{144}Ce were low. Artificial radioactivity was lower in fish from rivers and streams than in fish from lakes. Especially high values were measured in fish caught out of lakes with a long renewal time and with a long-term presence of radioactive fallout. In these lakes ^{137}Cs and ^{90}Sr in the critical freshwater fish organs by a factor of 9000 and 2000, respectively. (BBB)

31077 ANALYSIS OF THE NEED OF AN INCREASED SUPPLY OF CALCIUM FOR THE POPULATION TO DECREASE THE UPTAKE OF ^{90}Sr FROM RADIOACTIVE FALLOUT. Abramson, E.; Lindquist, B.; Luft, R.; Nelson, A. Sv. Lekartidn., 61: 1563-79(May 6, 1964). (In Swedish).

Numerous data relating to ^{90}Sr content of various constituents of the biosphere are reviewed, along with different procedures that were proposed for limiting the human intake of ^{90}Sr. Strontium metabolism in relation to that of Ca is explained preliminary to a review of proposals for elevation of Ca intake and stable Sr ingestion for reducing Sr absorption from the gut. Guidelines for monitoring and assessing the levels of ^{90}Sr considered hazardous to health are outlined. Processes for decontamination of ^{90}Sr-containing milk are mentioned, as well as dairy practices that tend to curtail the entry of the radionuclide into milk and milk products. Tables are provided that show the ^{90}Sr levels in various foodstuffs in Sweden, Denmark, Norway, Finland, Germany, Canada, Italy, and the United States. It is concluded that present levels of radiostrontium in foodstuffs do not warrant introduction of any of the proposed Sr-lowering processes in the dairy industry. (BBB)

31078 BAD NEWS FOR ASTRONAUTS. Marwick, Charles. New Sci., 37: 462-3(Feb. 1968).

Preliminary results of the Biosatellite program have been announced. The findings hint that the radiation safety levels in manned flights have not been high enough. (auth) (UK)

31079 CALCULATION OF THE ENERGY SPECTRA OF SLOWED DOWN ELECTRONS AT VARIOUS ABSORBER DEPTHS. Harder, Dietrich (Univ., Wuerzburg, Ger.). Biophysik, 4: 38-47(1967). (In German).

The depth dependent energy spectrum of slowed down electrons and their Δ particles was calculated by differences of the depth independent slowing down spectrum of McGinnies according to the initial energy and by assignment of this energy to the depth. The decrease of the primary electron flux density with the depth was considered. The spectrum calculated for 14-MeV initial energy in water showed a depth dependent modification in the total detected energy region from 0.5 to 100 keV which however amounts to only 11% in the low energy part. These are critical consequences for the evaluation of results of radiobiological studies at various depths. (tr-auth)

31080 COMPONENTS AND ESTIMATES OF DOSE TO ROOTS OF POTTED PLANTS EXPOSED TO FAST NEUTRON RADIATION. Curlin, J. W.; Witherspoon, J. P. (Oak Ridge National Lab., Tenn.). Health Phys., 14: 165-8(Feb. 1968).

The dose delivered to roots within a soil mass is difficult to estimate since the total dose is the integrated result of the incident neutrons and ionizing radiation from both soil activation products and direct activation within the plants. In addition, plant roots take in some of the soil activation products, which can be translocated to other plant parts. The study described was devised to provide estimates of the dose received by roots from (a) reactor fast neutrons, and (b) external β and γ radiation resulting from neutron activated soil minerals. A colluvial soil derived from dolomitic limestone material, comparatively rich in exchangeable bases, was used for the tests, which involved exposure to 2056 tissue rads of fast neutrons during a 10 min. period. Radionuclides identified as the major contributors of the induced gamma activity were ^{56}Mn, ^{51}Cr, ^{181}Hf, and ^{95}Zr−Nb. The average concentration for all the radionuclides identified was 0.211 μCi/g, ^{56}Mn being responsible for 95.6% of this total initial activity. The dose to the centre of the soil mass from activation products (12.8R) represented only 1.1% of the total dose. Fission gamma rays from the reactor accounted for most of the γ dose (2.8% of total dose). Thermal neutron dose was very small (0.4R), while the dose from neutrons $\geq$1 keV accounted for 96% of the total dose. Any effect of radiation on a root system in the soil would therefore be due primarily to fast neutron interactions. The dose to a root system growing in the soil due to radionuclides absorbed by root tissues would be expected to be small compared with the fast neutron dose. (UK)

31081 COMPOSITION OF TRABECULAR BONE IN CHILDREN AND ITS RELATION TO RADIATION DOSIMETRY. Dyson, E. D.; Whitehouse, W. J. (Atomic Energy Research Establishment, Harwell, Eng.). Nature (London), 217: 576-8(Feb. 10, 1968).

Trabecular bone is a composite tissue containing both bone marrow and bony tissue, but the radiation dose to the composite tissue from a β-emitting bone seeking nuclide is, to a first approximation, proportional to the amount of bone present. Children are of particular interest in this connection because of the rapid turnover of their bone mineral. The results of chemical analyses of specimens of trabecular bone from young children are reported, which enable the amount of bone tissue therein to be estimated. The results indicated that for children about 18 months old the proportion of bony tissue in trabecular bone from vertebral bodies and the upper end of the femur is about 25%. Results are compared with those obtained by other investigators. (UK)

31082 CORRELATION OF RADIATION EXPOSURE AND ^{210}Pb IN URANIUM MINERS. Black, Stuart C. (Memorial Aid Fund, Inc., Grand Junction, Colo); Archer, Victor E.; Dixon, Willard C. Health Phys., 14: 81-93(Feb. 1968).

Bone samples from thirty-two uranium miners and eight nonminers were analyzed for ^{210}Pb content. An estimate of cumulative radiation exposure to radon decay products in uranium mines was made for each man and correlated with his bone ^{210}Pb, both before and after adjustments for excretion were made. There was a definite correlation between exposure and bone ^{210}Pb as measured, but the correlation was somewhat better when adjustment for lead excretion was made. The concentration of ^{210}Pb in the bone of uranium miners is related to cumulative exposure (expressed as Working Level Months) by a power function: $\mathrm{pCi/g} = 4.27 \times 10^{-5}\,(\mathrm{WLM})^{1.439}$. By using a number of reasonable assumptions it was possible to calculate back from the bone ^{210}Pb to determine the amount of radon daughters inhaled and retained, and from this to calculate radiation dosage delivered to bronchial tissue. These calculations indicate that one Working Level Month delivers approximately 2 rad to bronchial tissue. (auth) (UK)

31083 COURSE IN TIME OF THE STRONTIUM RETENTION IN MAN. Mueller, J.; Thomas, J. (Inst. of Radiation Hygiene, Prague). Health Phys., 14: 285-92(Apr. 1968).

The body burdens of ^{90}Sr in nine luminizers were determined, in the time period of 900 to 2600 days following intake, by excretion analysis using a power function; the power of the time in days $b = 0.412 \pm 0.072$ was ascertained. A method is suggested for combining these results of analysis of the middle phase of the strontium retention with the results of the early phase. Using the data of Bishop et al. to describe the early phase leads to the exponent $b = 0.304 \pm 0.013$, and to the initial correction $\epsilon = 0.259 \pm 0.077$ days for the retention power function in Marshall's modified form. The terminal biological half-life for the late phase of retention is estimated to be $T = 9000 \pm 1100$ days by the use of the data available on stable strontium as well as the parameters b and ϵ and using the value $f_1 = 20\%$. The three parameters b, ϵ, and T describe the retention of strontium during the whole course according to the relation

$$R_s(t) = \left\langle \begin{array}{ll} 0.66(t + 0.26)^{-0.30} & 0 \leq t \leq 4000 \text{ days} \\ & \text{with} \\ 0.072e^{-0.693t/9000} & t \geq 4000 \text{ days.} \end{array} \right.$$

(auth) (UK)

31084 DEPTH-DEPENDENT CHANGES OF RBE, LET, AND ENERGY SPECTRUM IN HIGH-ENERGY ELECTRON RADIATION. II. THE ENERGY SPECTRUM OF THE RADIOBIOLOGICAL EFFECT AND THE DEPTH DEPENDENCE OF THE RBE. Hagemann, Gerd (Univ., Marburg, Ger.). Biophysik, 4: 155-67(1967). (In German).

The radiobiological effect proportional to the product of the electron flux density and a spectral sensitivity function corresponding to the physical interaction with the biological model was established for the calculation of the RBE. The application of the spectral function determined for the case of the transition of ionization and excitation energy to the cell nucleus by high-energy electrons yields the correct depth dependence of the RBE only for energies between 5 and 10 keV. The same is valid for the transition of ionization energy to the cell nucleus by K-shell ionization of biological important elements with consequent Auger effect (schrapnel effect). In the assumption of energy transfer by plasmon excitation or individual ionizations, no increase of the RBE with the depth corresponding to experiment was obtained. (tr-auth)

31085 DOSES TO BRAIN, SKULL AND THYROID, FOLLOWING X-RAY THERAPY FOR TINEA CAPITIS. Werner, A.; Modan, B.; Davidoff, D. (Tel Hashomer Government Hospital, Israel). Phys. Med. Biol., 13: 247-58(Apr. 1968).

In the course of a follow-up study of children irradiated for ringworm infection of the scalp in Israel, the radiation dose reaching the brain, skull and thyroid was measured. The measurements were performed with the aid of a phantom in conditions similar to those employed originally. The phantom was irradiated in 5 fields at 350 R per field. The upper layers of the brain received radiation doses between 121 and 139 rads, while the doses on the lower layer (2.5 cm deep) were smaller by 8 to 20%. The average radiation dose absorbed in the thyroid area was 6.5 rads. The dose absorbed in the outer layer of the skull was estimated to be 4.4 times higher than the dose absorbed by the adjacent skin. (auth) (UK)

31086 DEPTH DOSE MEASUREMENTS WITH LITHIUM FLUORIDE. Hendee, W. R.; Golden, R.; Garciga, C. E.; Gilbert, D. B.; Ibbott, G. S. (Univ. of Colorado, Denver). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 102: 694-6(Mar. 1968).

Per cent depth doses were measured with LiF thermoluminescent dosimeters and ionization chambers in water phantoms exposed to orthovoltage x rays and cobalt-60 radiation. Agreement within ±1% was achieved between LiF and ionization chamber measurements of ^{60}Co per cent depth dose. Unsatisfactory results were obtained with LiF measurements of per cent depth dose from orthovoltage x rays. (auth)

31087 EXPERIENCE WITH COMPUTERIZED IMPLANT DOSIMETRY. Holt, G.; Hilaris, B.; Balter, S.; Ragazzoni, G. D.; Phillips, R. F.; Laughlin, J. S. (Memorial Hospital for Cancer and Allied Diseases, New York). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 102: 688-93(Mar. 1968).

Computers, by their ability to perform many calculations accurately and rapidly, make it possible to obtain and display information which would otherwise not be feasibly obtainable. Computerized treatment planning for internal γ sources obviously provides a more accurate and more complete determination of radiation dosage; it also demands more precise clinical data and thus tends to raise the level of all the work in the radiotherapy center. (auth)

31088 INTRACAVITARY THERAPY WITH RADIOACTIVE IRIDIUM ASSOCIATED TO THE SURGERY IN THE TREATMENT OF SOME NEOPLASMS OF THE PARANASAL SINUSES. Jucker, C.; Ferrari Parabita, G.; Squassabia, A. (Univ., Pavia, Italy). Radiol. Med., 53: 687-703(July 1967). (In Italian).

The advantages from the use of ^{192}Ir in contact radiotherapy, carried out after surgical operation, of some tumors of the paranasal sinuses are discussed. The employment of the ^{192}Ir in molds, prepared according to the technique of the nonradioactive preparation (afterloading), is reliable and it assures low doses of exposure. (auth)

31089 INDUSTRIAL RADIATION CATARACT: THE HAZARDS AND THE PROTECTIVE MEASURES. Edbrooke, Clare M.; Edwards, Carolyn (Northampton Coll. of Advanced Tech., London). Ann. Occup. Hyg., 10: 293-304(Oct. 1967).

A literature review of industrial radiation cataract is presented. The clinical appearance of infra-red cataracts of glass workers is described. The transmission and absorption of various wavelengths of light by the cornea, aqueous humor, and crystalline lens is discussed. Hazards of uv radiation from molten glass, infra-red radiation from electric welding arcs, secondary heat sources from electric welding filters and other types of industrial hazards are reviewed. Protection standards of various countries are reviewed. It is pointed out that effectiveness of standards cannot be compared from the incidence of industrial cataract in the various countries, since incidence of cataract today results from exposure to radiation 15 to 30 years ago and relates to protection in use at that time. (H.L.W.)

31090 MATHEMATICAL MODEL FOR DETERMINING LOW ^{226}Ra BODY BURDENS FROM ^{222}Rn IN THE BREATH. Hickey, John L. S.; Campbell, Samuel D. (National Center for Radiological Health, Rockville, Md.). Health Phys., 14: 119-25(Feb. 1968).

A mathematical model is described for determining ^{226}Ra body burdens from measurements of ^{222}Rn in the breath. The model permits investigators to distinguish between that portion of radon in the breath due to a radium body burden and that due to release of atmospheric radon from the body. The radium body burden is determined from the radon content of three breath samples taken during a limited acclimation period in an atmosphere of known, low-radon concentration. This method makes it unnecessary for the subject to reach full equilibrium with the low-radon atmosphere and eliminates the need for a correction factor to account for release of residual atmospheric radon in the breath. The effect of breathing rate on the release of previously inhaled atmospheric radon from the body is discussed. (auth)

31091 MEASUREMENT OF ^{131}I CONTAMINATION IN FRESH MILK. Tuang, Wei; Huang, Yin-si; Tsai, Chao-ming; Tseng, Chia-lian (National Ching-hwa Univ., Taiwan). T'ai-Wan I H'sueh Hui Tsa Chih, 65: 259-62(May 1966). (In Chinese).

Radiation contamination of milk by radioiodine as the result of fallout from the second thermonuclear test on the Chinese mainland was examined. The milk proteins were precipitated with 30% trichloroacetic acid and the supernatant was passed through the anionic ion exchange resin Dowex 2 × 4 (20 to 50 mesh). Radioactive iodine was extracted with carbon tetrachloride and finally precipitated as Ag^{131}I. This precipitate was dried and measured with a GM counter. Twelve to 15 days after the second nuclear test on the Chinese mainland (May 14, 1965), the ^{131}I content of milk was found to be 5.36×10^{-2} to 2.0×10^{-2} μCi/ml while the ^{131}I content in rainwater around this period (7 to 12 days after the nuclear test) was 1.67×10^{-1} to 8.6×10^{-3} μCi/ml. It was observed that the peak production of ^{131}I from a nuclear test occurs ~16 days after the explosion and then gradually disappears in one month. There was some correlation between the ^{131}I content of milk and the total β radiation of the rainwater collected during the same period. Some plants, vegetables, and rice might likewise be contaminated with radioactivity after a nuclear test. The method described may serve as a simple and rapid technique for the measurement of ^{131}I contamination of food. (BBB)

31092 MEASUREMENT OF THE DIFFUSION COEFFICIENT OF RADIUM A. Raabe, O. G. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Nature (London), 217: 1143-5(Mar. 23, 1968).

The diffusion of ^{218}Po (RaA) (half-life 3.825 days) is of special interest in connection with the potential hazard in mines from the inhalation of daughter products of radon. It is possible that the RaA ion is quickly neutralized and forms polonium oxide. RaA rapidly becomes attached to aerosol particles at a rate dependent on the aerosol concentration and on the diffusion coefficient. If unattached RaA is inhaled it deposits by diffusion on the walls of the respiratory tract, the amount deposited and the site of deposition depending on the diffusion coefficient. The importance of water molecule interactions was studied under two different conditions of humidity, and an apparent effect of humidity on the diffusion coefficient was found. Experimental details are described. The calculated diffusion coefficients were 0.047 cm^2/sec and 0.034 cm^2/sec. Clustering of water molecules around the RaA ions may explain the apparent diminution of the diffusion coefficient with increased humidity. Chemical reactions, such as oxide formation, may also be involved. (UK)

31093 MEDICAL CONSIDERATIONS AND GUIDE LINES ON PERSONNEL DECONTAMINATION. PART I. Moehrle, G. (Kernforschungszentrums, Karlsruhe, Ger.). Atompraxis, 14: 69-73(Feb. 1968). (In German).

Procedures and equipment for the removal of radioactive material emitting α, β, or γ radiations from the skin of personnel of nuclear energy industry are described. Medical methods for the removal of radioactive materials from puncture wounds are also discussed. (C.H.)

31094 PERFORMANCE OF A 6 MeV VARIAN LINEAR ACCELERATOR. Horsley, R. J.; Price, R. H.; Saunders, J. E.; Dingwall, P. W. (Ontario Cancer Treatment and Research Foundation, Hamilton). Brit. J. Radiol., 41: 312-16(Apr. 1968).

The performance of a Varian 6 MeV Linear Accelerator in which the electron beam is bent through 90° is reported. Initially the machine was unacceptable for treatment purposes mainly because of variations in the asymmetry of the x-ray beam. The steps taken to correct the causes of asymmetry are described together with the improved behavior of the machine. It is emphasized that care must be taken in the initial positioning of the beam flattener, in adjusting the symmetry servo amplifier and in the daily checking of magnetron frequency and beam energy. Measured central axis depth dose data are available for a range of square field sizes from 4 × 4 cm to 25 × 25 cm to a depth of 30 cm for 100 cm SSD and similar data for 92.5 and 85 cm SSD are available from the authors. (auth)

31095 PROBLEMS ENCOUNTERED IN THE DETERMINATION OF THE RADIOACTIVE IODINE UPTAKE. Manfred Leuthard, R. T. (Wellesley Hospital, Toronto). Can. J. Med. Technol., 30: 28-36(Feb. 1968).

Major variables are discussed and some technical improvements over earlier uptake measurements are described. (Canada)

31096 PULSE POLAROGRAPHY: ANALYTICAL METHOD IN RADIOPROTECTION. Chapron, Yves; Francois, Henri (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France). Radioprotection, 1: 33-54(1966). (In French).

Radioprotection necessitates the use of very delicate analytical methods. It is shown that pulse polarography is an optimum method. Pulse polarography is described, and its limitations and extensions are indicated. An extension of the method is developed. The results permit the analysis of uranium beginning with the concentration of 10 ppM. (tr-auth)

31097 PREVENTION OF ACCIDENTS OF NUCLEAR ORIGIN. Duhamel, Francis. Radioprotection, 1: 5-13(1966). (In French).

In the evaluation of nuclear safety, the concept of maximum credible accident is commonly used. It is proposed that a more valid concept would be the summation of more probable, less serious accidents. An example is given of the concrete results that can be obtained. (J.S.R.)

31098 REPORT TO THE ATOMIC ENERGY COMMISSION BY THE RADIOISOTOPES LICENSING REVIEW PANEL, SEPT. 5, 1967. **Isotop. Radiat. Technol., 5: 315-31(Summer 1968).**

A review panel appointed by the USAEC from outside government reviewed the USAEC's policies, procedures, and regulations for licensing and regulating the uses of radioisotopes. Their report, submitted Sept. 5, 1967, concludes that the Commission's program on the whole has been well conceived and well administered and the Panel has no doubt of its contribution to an excellent health and safety record.... The Panel indicated that simplification of regulations should encourage more applications of radioisotopes and improve the effectiveness of USAEC's regulatory program. The full text of the Panel's report is given here. (auth)

31099 RESOLUTION RELATIVE TO THE STATE OF PROTECTION AGAINST IONIZING RADIATIONS IN BELGIUM. **Bull. Acad. Roy. Med. Belg., 7: 389-90(1967). (In French).**

The Royal Academy of Medicine, was pleased at the aid accorded radioprotection research by the Ministry of the Interior; confirmed that the Ministries of Public Health and of Labor had put into action a detailed plan for the protection of nuclear industry workers, researchers, and the general population; hoped that efficacious control would ensure compliance with those measures; insisted that authorities took all precautions necessary to ensure that the number of fluoroscopic and radiographic examinations of one patient be kept to a minimum, with transmission of the relevant radiographic files, if appropriate; insisted on the importance of progress in radiobiology, notably in health physics, for the peaceful development of atomic energy; called on the prime minister and the ministers of economic affairs, education, public health, and agriculture to assure that the radiobiology department at Mol received the financial and technical aid necessary for its activities and called on the competent authorities to give a definitive status to the radiobiology department at Mol, which had demonstrated its efficacy and whose work was indispensable to the security both of the general population and of the workers in the field of nuclear energy. (BBB)

31100 RESULTS OF THE PENNSYLVANIA DEPARTMENT OF HEALTH DENTAL X-RAY SURVEY PROGRAM. **Lubenau, Joel O. (Pennsylvania Dept. of Health, Harrisburg); Gerusky, Thomas M.; Haughey, Francis J. Health Phys., 14: 151-5(Feb. 1968).**

Following the promulgation of the Regulation for Radiation Protection, Article 433, in 1956, the Pennsylvania Department of Health initiated a survey program of dental x-ray equipment. A 43% reduction in exposure output at the tip of the cone was determined to have occurred between 1956 and 1966. Thirty-eight per cent was a result of satisfying regulatory requirements and the remainder resulted from improvements in radiographic techniques by the operators. The present average annual individual gonadal exposure from dental radiography is estimated to be 0.06 to 0.6 mR. Further exposure reductions can be expected following adoption of long cone techniques, ultra-fast films, high energy developers, and longer developing times, and high kVp techniques. It is estimated that if all dental x-ray equipment is operated at the maximum kVp rating with ultra-fast film, a further reduction of 70% of dental x-ray exposure could be realized. (auth)

31101 RADIATION PROTECTION STUDY APPROVED BY UNITED STATES PUBLIC HEALTH SERVICE AND THE AMERICAN PODIATRY ASSOCIATION. **J. Amer. Podiat. Ass., 57: 92(Feb. 1967).**

The American Podiatry Association, under contract from the U. S. Public Health Service, Division of Radiological Health, was developing a method to evaluate the radiation protection aspects of the use of x rays in the podiatry profession. A survey of the podiatry profession was being made to evaluate the existing use of radiographic equipment and techniques in podiatry. The first phase of the study consisted of a questionnaire designed to provide data for program planning and development. Phase two would be the pilot evaluation for phase three, both of which would use a special film pack method to provide such vital information as x-ray beam size and total filtration in the useful beam. Phase four would include an education program on radiologic health. (BBB)

31102 SURVEYING FOR TRITIUM RELEASED FROM LABELED COMPOUNDS IN REFRIGERATED STORAGE. **Hansen, W. R.; Yoder, L. B. (Univ. of Colorado, Boulder). Health Phys., 14: 170(Feb. 1968).**

Health Physicists are often asked to survey storage conditions for tritium-labeled water and other compounds. Biochemical and biological research workers often place tritium-labeled compounds in refrigerated storage to prevent decomposition. During the storage period, inadequate storage containers, coupled with self-radiolysis and decomposition cause release of HTO. The atmosphere of tritium in the refrigeration unit can be a hazard for personnel who are opening the unit, or can contaminate experimental solutions placed in the unit that are to be analyzed later for trace amounts of tritium. A rapid method for routine tritium surveys of refrigerated storage is described, involving the collection of samples of the frost that forms around the freezer unit of refrigerators or the shelves and sides of freezers. The method has served as a fast check of a storage unit for inadequate storage of tritium compounds. (auth) (UK)

31103 SERUM LDH AND MDH CHANGES DURING RADIOTHERAPY OF FEMALE GENITAL CARCINOMA. **Tympanidis, K. (Univ., Athens). Geburtsh. Frauenheilk., 26: 801-3(May 1966). (In German).**

The results from evaluation of serum lactic dehydrogenase (LDH) and serum malic dehydrogenase (MDH) in 25 female patients with various types of genital carcinomas who were given combined Ra and x radiation treatments are reported. Typical treatments consisted of three Ra implantations giving total doses of 4320 to 5760 mg-hr, and fractionated x irradiation given in 20 exposures, with total focal dose in four fields of from 3120 to 4000 R. Decreases in enzymatic activities observed were taken to indicate injury to tumor cell mitochondria and increased glycolysis. Unchanged serum levels of the enzymes were ascribed to tumor radioresistance. Where decreases were observed increased formation of H_2O_2 in the tumor cells because of catalase lack may have damaged energy-producing reactions. MDH was an indicator of disturbances of cell respiration and mitochondrial structure. Since LDH is a glycolytic enzyme that may reflect increased tumor glycolysis it could be specific for evidence of tumor activity. Simple estimation of these two enzymes in serum could serve as indications for the efficacy of radiotherapy. (BBB)

31104 STANDARDS OF GAMMA RADIATION INTENSITY FOR INDUSTRIAL AND MEDICAL GAMMA INSTALLATIONS. **Terman, A. V. Gig. Sanit., No. 3, 45-8(Mar. 1968). (In Russian).**

Existing standards of the U.S.S.R. regarding permissible limits of the intensity of γ radiation on the surface and at a distance of 1 m from the surface in industrial and medical installations are reviewed. The short-comings of each of the standardization principles are considered. Separate standards are suggested for the intensity of gamma-radiation from stationary and transportable gamma installations, with due regard for the actual working site of the operator. It is suggested that standards intended for stationary gamma installations should limit the radiation intensity existing at a distance of 1 m from the radiation source, and those intended for transportable installations should limit the radiation intensity on the surface of the protective shield of the gamma installation. (C.H.)

31105 THE M. D. ANDERSON METHOD FOR THE COMPUTATION OF ISODOSE CURVES AROUND INTERSTITIAL AND INTRACAVITARY RADIATION SOURCES. I. DOSE FROM LINEAR SOURCES. **Shalek, Robert J.; Stovall, Marilyn (M. D. Anderson Hospital and Tumor Inst., Houston, Tex.). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 102: 662-72(Mar. 1968).**

A review of the physical factors that are used to compute the dose in Rads at points around linear radium sources has included a consideration of the γ absorption in the radioactive source and the container, the effect of cellularity in the source construction, and the effective absorption coefficients for use with the Sievert integral. The effective attenuation in tissue of the γ rays of gold-198, iridium-192, cesium-137, radium-226, and cobalt-60 was also considered. New tables based upon recent experimental data are given for the radiation dose around linear radium sources. (53 references.) (auth)

31106 THE STATE OF PROTECTION AGAINST IONIZING RADIATION IN BELGIUM. **Bacq, Z. M. Bull. Acad. Roy. Med. Belg., 7: 351-61(1967). (In French).**

Formation of a cadre of radiobiologists and health physics technicians should be considered a community obligation. Several chances for international collaboration had been missed; at the national level, perspectives were not encouraging. Governmental control and reorganization of radiobiology was called for. The Department of Public Health had not contributed more than work on a few contracts with the Department of Radiobiology at Mol to the problem of direction of scientific research; some construction of facilities had been carried out with Euratom support which could not be renewed. A review of European cooperation in this area produced little to comment on, but European radiobiologists had created an association, the European Society for Radiation Biology, which had called on governments to expand their support in this and related fields, notably at the international level. Establishment of a central European health physics laboratory under the auspices of the W.H.O., and thus the U.N., had been discouraged by the United States, the Soviet Union, and the United Kingdom. All of this indicated that Europeans were intended to remain part of the clientele of the major powers and led to an observable degradation of the European spirit. (BBB)

31107 THERMOLUMINESCENT INTERNAL BETA-RAY DOSIMETRY. Kastner, Jacob; Hukkoo, Ramesh; Oltman, B. G.; Dayal, Y. (Argonne National Lab., Ill.). Radiat. Res., 32: 625-40(1967).

The possibility of using thermoluminescence for in vivo and in vitro direct dose measurements in tiny body cavities (for example, bone marrow) suggested investigation of the response to beta radiation of LiF and CaF_2 powder and single crystals of different thicknesses down to microns. Several beta-ray sources were made in the form of gelatin or polyester resin molds. The emitters consisted of ^{3}H, ^{63}Ni, ^{35}S, ^{45}Ca, ^{204}Tl, and ^{90}Sr (^{90}Y), and the absorbed dose rate was computed from the known concentration in each case. As expected, the thermoluminescent output per unit weight and per unit absorbed dose was essentially the same for ^{204}Tl and ^{90}Sr as for ^{60}Co but dropped for the lower-energy beta-ray emitters. Among the factors considered which might account for the drop in light output were the relation of the beta-ray range to the physical size of a grain of the compound, the existence of a "dead" surface layer, and the effect of high specific ionization on light output. For example, to check the latter possibility, monoenergetic conversion electrons of widely different energies were employed to irradiate single crystals in order to evaluate the light output per erg absorbed; this ratio was found to be independent of the specific ionization existing under these conditions. It seems that this form of dosimetry is quite feasible, even for tritium, provided careful precalibration is carried out with a sample of the specific batch to be employed. Applications to the dosimetry of beta-ray applicators were described. (auth)

31108 THE USE OF ELECTRON COMPUTERS FOR DOSE DISTRIBUTION CALCULATION OF ^{60}CO GAMMA RADIATION WITH SPECIAL CONSIDERATION OF THE HETEROGENICITY OF THE ENVIRONMENT. Klepper, L. Ya. (Mathematical Laboratory of the Inst. of Medical Radiology, Moscow). Med. Radiol., 12: No. 10, 13-20(Oct. 1967). (In Russian).

The article describes the algorithm of dose distribution calculation by the given sum total of irradiation directions with special consideration of the heterogenicity of the environment after the method of Dutreix et al. It is supposed that there will be a conditional-cipher system of coding the information on the structure of the irradiated organism in the given section for introduction into the memory of the electron computer. In order to calculate the dose distribution the author employed a formula based on linear interpolation. On the basis of the algorithm described the author elaborated programs the principal aim of which is to yield initial information for solving the tasks of choosing optimal conditions of irradiation. (auth)

31109 USE OF CYTOGENETIC EFFECTS IN BIOLOGICAL DOSIMETRY. Biola, M. T. (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France). Radioprotection, 1: 67-87 (1966). (In French).

A bibliographic study is made of the use of cytogenetic effects in biological dosimetry and of the results obtained. The cellular cycle phase permitting the best observation of chromosomes is the metaphase and this is the one selected for cytogenetic studies. The techniques used are briefly described. Probable mechanisms for the formation of chromosome anomalies are outlined, and the types of anomalies found in cultured leukocytes from man are described. The theoretical probability for obtaining chromosome anomalies is discussed. The dose/effect relation observed in blood cells is considered. The estimation of the dose received during in vivo irradiation is described. (J.S.R.)

31110 SCIENTIFIC REPORTS ON INDUSTRIAL HYGIENE AND OCCUPATIONAL DISEASES IN CZECHOSLOVAKIA, 1965. VOLUME 10. Prague, Inst. of Industrial Hygiene and Occupational Diseases, 1968. 184p. (In English and Russian).

An annual review is given of literature published in the field of occupational health in Czechoslovakia. The most recent edition (covering the year 1965) contains 292 abstracts in English of books and articles, classified under the following headings: general aspects and organization of occupational health; working environment; biological effects of substances and materials (radiations are also covered in this section); occupational diseases; occupational physiology and psychology; methods and apparatuses; work safety and equipment; various books. An alphabetical subject index and a list of authors are provided. (Occup. Safety and Health Abstr.)

31111 SPECIFICATION FOR X-RAY PROTECTIVE LEAD GLASSES. B. S. 4031. London, British Standards Inst., 1966. 7p. 3s.

This standard specifies essential requirements in Great Britain for lead barium silicate and lead silicate glasses for protection against x radiation, including a method of measuring the lead equivalent. (Occup. Safety and Health Abstr.)

31112 THE RADIOACTIVE SUBSTANCES (ELECTRONIC VALVES) EXEMPTION ORDER, 1967. U. K. Government Statutory Instruments No. 1797/1967. London, Her Majesty's Stationery Office, 1967. 6p. 10d.

This Order exempts persons (in some cases conditionally) from registration under the Radioactive Substances Act 1960 in respect of the keeping and use, except on manufacturers' premises, of radioactive materials consisting of electronic valves possessing limited radioactivity, and instruments incorporating such valves. It also exempts persons unconditionally from registration in respect to mobile radioactive apparatus incorporating such valves. The Order also applies radioactive waste associated with such valves. The Order revokes and replaces the Radioactive Substances (Electronic Valves) Exemption Order 1962, but reproduces the provisions of that Order without amendment except for the inclusion of valves containing ^{147}Pm, the raising of the limits of radioactivity of an exempted valve containing tritium or ^{85}Kr, and the revision of the formula for limiting the radioactivity of a valve containing more than one specified radionuclide. (UK)

31113 THE RADIOACTIVE SUBSTANCES (FIRE DETECTORS) EXEMPTION ORDER, 1967. U. K. Government Statutory Instruments No. 1796/1967. London, Her Majesty's Stationery Office, 1967. 4p. 8d.

This Order exempts persons conditionally from registration under the Radioactive Substances Act 1960 in respect of the keeping and use of radioactive material consisting of fire detectors, attached to premises, which incorporate closed sources possessing limited radioactivity. The Order also applies conditionally to radioactive waste associated with such stores. The Order revokes and replaces the Radioactive Substances (Fire Detectors) Exemption Order 1962, but reproduces the provisions of that Order without amendment except for the raising of the limits of radioactivity of incorporated sources containing ^{85}Kr, and the conditional exclusion from the Act of gaseous waste containing ^{85}Kr arising from such sources. (UK)

31114 INVESTIGATION ON THE EFFICIENCY OF DECONTAMINATION BY A WATER VAPOUR JET. Siemaszko, Aleksander; Oglaza, Jan; Czerkawski, Antoni (Inst. of Nuclear Research, Warsaw). Nukleonika, 13: 177-85(1968). (In Polish).

The efficiency of decontamination of six kinds of surfaces and two ready products has been examined using aqueous solutions of radioisotopes or a radioactive dust as contaminants. A water vapor jet either alone or with surface active and complexing compounds was used as a decontaminating agent. (auth)

31115 MEASUREMENTS OF THE QUALITY FACTOR FOR HIGH ENERGY PROTONS IN THE WATER PHANTOM. Zel'chin'skii, Mechislav; Komochkov, Mikhail M.; Sychev, Boris S.; Cherevatenko, Anatolii P. Nukleonika, 13: 165-70(1968). (In Russian).

The depth distribution of the quality factor (QF) for high energy protons is found experimentally. The measurements were performed using a tissue-equivalent recombination chamber, remotely moved along the axis of the cylindrical 80-liter phantom. The values of QF for protons with energies of 660 MeV and 260 MeV are found to be 1.8 ± 0.3 and 1.2 ± 0.2, respectively, and hardly dependent on depth, but increasing sharply at the limit of the primary proton range. (auth)

Medicine

Refer also to abstracts 30782, 30792, 30829, 30841, 31067, 31085–31088, 31101, 31103, 31105, 31214, 31215, 31220, 31228, 31236, 31245, 31247, 31252, 31258, 31272–31274, 31283, 31284, 32377, 32577, and 32578.

31116 ADVANCES IN NUCLEAR MEDICINE. Heagy, Fred C. (Victoria Hospital, London, Can.). Trans. Amer. Nucl. Soc., 11: 58(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31117 INFORMATION PROGRESSING IN NUCLEAR MEDICINE. Belque, R. A. (Hospital Notre Dame, Montreal); Rotenberg, A. D. Trans. Amer. Nucl. Soc., 11: 65-6(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31118 CURARIZING ACTION OF SOME NEW RADIOPROTECTIVE SUBSTANCES. Niculescu, Gh.; Popa-Zeletin, I.; Manolescu, Em.; Enea, Cristinel. Rev. Sanit. Mil., 62: 861-5 (Sept.-Oct. 1966). (In Rumanian).

Clear evidence of curarizing activity was found in six radioprotective substances by in vitro studies. The substances tested were: phenacyloxime-2-mercaptoethyl dimethylammonium bromide; bis-[dimethyl-phenacyloxime]-diethyl-disulphur bromide; dimethyl cystamine; dimethylamino-diethyl disulfur; trimethyl-mercaptoethyl ammonium; and bis-[trimethylamino]-diethyl-disulfur iodide. (CFSTI)

31119 USING THE EYES OF A DOG AS A SCINTILLATION DETECTOR FOR NUCLEAR AND X RADIATION. Roesel, O. F.; Bailey, R. E. (Purdue Univ., Lafayette, Ind.). Trans. Amer. Nucl. Soc., 11: 61-2(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31120 STUDIES OF PULMONARY FUNCTION USING THE SCINTILLATION CAMERA AND ^{133}Xe FOR EVALUATION OF TOPICAL VENTILATION AND BLOOD FLOW IN MAN. Newhouse, M. T.; Wright, F. J.; Ingham, G. K.; Hughes, L.; Hopkins, O. (St. Joseph's Hospital, Hamilton, Ont.). Trans. Amer. Nucl. Soc., 11: 58(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31121 ANATOMIC AND FUNCTIONAL THYROID DETAIL AS OBTAINED WITH SPINTHARICON IMAGING. Lofstrom, James E.; Horwitz, Norman H.; Forsaith, Ann L. (William Beaumont Hospital, Royal Oak, Mich.). Trans. Amer. Nucl. Soc., 11: 68-9(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31122 ^{90}Y IMPLANTATION INTO PITUITARY TUMORS ASSOCIATED WITH ACROMEGALY. Dohn, Donald F.; McCullagh, E. Perry (Cleveland Clinic, Ohio). Trans. Amer. Nucl. Soc., 11: 58-9(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31123 RECENT TRENDS IN THE DEVELOPMENT OF RADIOTHERAPEUTIC EQUIPMENT. Herring, D. F. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc., 11: 397(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31124 FAST-NEUTRON BEAMS FOR RADIATION THERAPY. Brennan, James T. (Univ. of Pennsylvania, Philadelphia). Trans. Amer. Nucl. Soc., 11: 398(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31125 POSSIBILITIES AND ADVANTAGES OF USING NEGATIVE PIONS IN RADIOTHERAPY. Rosen, Louis (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc., 11: 397-8 (June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31126 MANAGEMENT OF MASS SURGICAL CASUALTIES IN NUCLEAR WAR. Stephen, R. A. J. Roy. Army Med. Corps., 113: 51-7(1967).

For casualties resulting from a thermonuclear war the main concern would be with the less seriously wounded who were most likely to survive. It would be necessary to assess quickly the chances of recovery of patients suffering from multiple injuries, including moderate burns, contusions, open wounds of varying extent and degree, fractures and limited crush injuries. Degrees of severity would vary from trivial flash burns with temporary blindness to immediately fatal conditions. Management and treatment should be considered in terms of the effects of complications such as anoxia, shock, and infection, and in relation to the passage of time and the effects of transportation. The clinical picture could change rapidly. The planning should therefore be flexible and related to the nature of treatment, whatever the conditions. Surgical treatment was considered under the following three headings: first-aid measures, urgent emergency surgery, and delayed surgery. In phase one, self-aid was all that could be available. Simple nonoperative measures of first aid would include the following: establishing a clear airway, prevention of blood loss and wound infection, and early immobilization of a fracture to avoid amputation. In phase two, urgent emergency surgical procedures should include the surgical control of accessible hemorrhage, amputation of shattered limbs, and provision for dependent drainage for the relief of pus under tension. Phase three, the delayed surgery of survivors, concerns a distinct field of surgery with difficult problems, and due to chaotic conditions, it would be a practical measure only after seven days. There would be an overwhelming and immediate need for wound closure. The definitive treatment of fractures, and other injuries, along with procedures such as the grafting of burns would have to await a more opportune time. Burn casualties would also be a significant problem since adequate treatment would not be possible. Those with 15 to 25% burns would be more likely to profit from available fluids if given as early as possible. (BBB)

31127 COMPLICATIONS OCCURRING AFTER FIVE YEARS IN PATIENTS WITH CARCINOMA OF THE CERVIX UTERI SUBJECTED TO RADIOTHERAPY. Lukawska, Krystyna; Kozakiewicz, Alicja. Nowotwory, 17: 277-83(July-Sept. 1967). (In Polish).

Eleven cases of post-irradiation complications that occurred 5 to 13 years after treatment of 2560 women with invasive carcinoma of the cervix uteri in the Institute of Oncology in Warsaw during 1947 to 1959 are presented. The most frequent complications were the post-irradiation lesions of the urinary bladder (5 patients). Less frequent were damages of the pelvic bones, cicatrizing lesions of intestines, skin necrosis, necrosis of the vaginal duct and constriction of the ureter. One out of 11 patients died because of post-irradiation complications. One patient died because of the late recurrence of the cancer. The cause of death of one patient remained unknown. (auth)

31128 EXPERIMENTAL STUDIES ON THE HYPOTENSION INDUCED BY RADIATION AND ITS TREATMENT WITH NORADRENALINE DERIVATIVES. Kleibel, Franz (Univ., Heidelberg). Med. Welt, No. 14, 725-8(Apr. 2, 1966). (In German).

The effects of irradiation treatments on induction of decreased blood pressure depend primarily on the condition of the patient, and secondarily on the irradiation dose and duration (volume dose and fractionation), and to a certain extent on the topography of the irradiation technique. The hypotension and orthostatic disorders that followed irradiation with several thousand roentgens of high-voltage radiation for various malignant tumors were studied in 72 patients of various ages. The hyperdiastolic disturbances were related to failure of the venous system, with diminution of the blood pressure amplitude, caused by a drop in the systolic pressure and an increase in the diastolic pressure, and an accelerated pulse rate. The hypodiastolic disturbances were due to failure of the peripheral autonomic regulatory systems of vasoconstriction. Systolic and diastolic pressures were low, and the pulse rate increased. It was found that treatment with tranquilizers, narcotics, bed-rest, and the sympatheticomimetic drug, DL-1-(3′-hydroxyphenyl)-2-aminoethanol hydrochloride improved the circulatory status of the patients. The drug dose was empirically determined from the severity of the radioinduced hypotension. The drug was about 95% effective in restoring the patients to normal circulatory status. (BBB)

31129 A SURGEON'S APPRAISAL OF THE LASER. Ketcham, Alfred S.; Hoye, Robert C.; Riggle, Grant C. (National Cancer Inst., Bethesda, Md.). Surg. Clin. N. Amer., 47: 1249-63(Oct. 1967).

The effects of lasers on tissue are reviewed and investigations on combined effects of laser and ionizing radiation on tumors are reported. Studies were conducted with x irradiation and cancer chemotherapeutic agents in an attempt to potentiate laser tissue interaction. With the S-91 melanoma tumor-host system, significantly higher tumor cure rates resulted from the combined use of cyclophosphamide with either the ruby or neodymium laser, than when these agents were used alone. When 5-fluorouracil was substituted for cyclophosphamide, these effects were not observed. In this same tumor-host system the combined use of x irradiation with neodymium laser was used to further improve the cure rate. X rays were administered only to the tumor, at different time intervals, preceding laser treatment. In the control (no treatment) group or in the mice receiving x irradiation alone, there were no cures. In the group receiving laser only, 39% were cured. In the group receiving irradiation followed by laser in 3 hr, 96% were cured. Similar results were also obtained in experiments in which x rays were administered at different time intervals either before or after the use of the laser. With the mammary adenocarcinoma in C3H mice as the tumor-host system, the adjuvant use of cyclophosphamide or x irradiation combined with laser did not enhance the cure rate over laser treatment alone. This potentiating effect of adjuvant agents, therefore, appeared to be selective. (BBB)

31130 ACUTE IRRADIATION PROCTITIS IN MAN: DEVELOPMENT OF EOSINOPHILIC CRYPT ABSCESSES. Gelfand, Martin D.; Tepper, Marcos; Katz, Leonard A.; Binder, Henry J.;

Yesner, Raymond; Floch, Martin H. (Yale Univ., New Haven). Gastroenterology, 54: 401-11(Mar. 1968).

A systematic evaluation was made of the symptoms, sigmoidoscopic findings, and histological and histochemical appearance of the rectal mucosa during and shortly after a standard course of radiation therapy for malignancies in the pelvic area. All 11 patients were treated by a 6-MeV linear accelerator. In seven cases the radiation was given through anterior and posterior portals about 15 cm square, with five patients receiving an estimated dose to the rectum of between 4000 rad in 28 days and 4600 rad in 32 days. Two patients received 3500 rad in 26 days and 6000 rad in 62 days respectively. The remaining four were treated by means of a three-field technique, estimated dose to the rectum varying from 4000 rad in 45 days to 5200 rad in 46 days to the anterior wall and from 1000 rad in 50 days to 3600 rad in 45 days to the posterior wall. The ensuing rectal abnormalities were similar in the two groups. The patients were studied at days 0, 10, and 20 during radiation therapy. The most striking feature seen, not previously reported, was the appearance of eosinophilic crypt abscesses. Some eosinophilic infiltration usually accompanied inflammation of the gastrointestinal tract of diverse etiologies, and intense tissue eosinophilia occurred in patients with nonspecific ulcerative colitis, particularly those in relapse. Treatment with corticosteroids diminished the intensity of eosinophilic infiltration. During the acute course of radiation therapy a marked focal tissue eosinophilia occurred with the development of the striking eosinophilic crypt abscesses. A lesser degree of tissue eosinophilia occurred in radiation damage to the small bowel. Since one function of the eosinophil was the phagocytosis of antigen-antibody complexes, tissue eosinophilia occurred as a reaction to injected foreign protein or to a protein liberated from the damaged rectal mucosa. (BBB)

31131 APPLICATION OF RADIOBIOLOGIC KNOWLEDGE AND CELLULAR KINETICS TO RADIATION THERAPY. Tubiana, M.; Frindel, E.; Malaise, E. (Institut Gustave-Roussy, Villejuif, France). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 102: 822-30(Apr. 1968).

Recent study showed that the radiosensitivity of a cell varied during the course of the cell cycle. The kinetics of cell proliferation of a tumor should, therefore, be related to its radiosensitivity. This fact emphasized the need of such studies in human and experimental tumors. Furthermore, the temporary arrest of the cell cycle following irradiation resulted in a variation of the radiosensitivity of the tissue that was being studied and measured. This and other factors, such as the variation of the growth rate of the surviving cells in an irradiated tissue, should be taken into account in the choice of the best fractionation. Study of all these factors in experimental, as well as in human tumors, will necessitate considerable future investigation to provide a rational basis for the development of radiotherapeutic procedures. (auth)

31132 ACTION OF γ RAYS OF ^{60}Co ON THE AUTOMATIC ACTIVITY OF THE LYMPHATIC HEARTS OF THE FROG. Murav'ev, M. N.; Tsypin, A. B. Dokl. Akad. Nauk SSSR, 177: 479-82(Nov. 11, 1967). (In Russian).

The effect of ionizing radiations on the automatic activity of organs was investigated on the rear lymphatic hearts of male frogs, Rana temporaria, actuated by the corresponding automatic centers located in the spinal cord. The rhythmic activity and the reaction to adrenalin were studied for two weeks after exposure to 50 kR of γ radiation from a 330 R/min ^{60}Co source; the effects of potassium and of 2,4-dinitrophenol on the radioinduced reaction were also examined. The automatic systole was recorded by an encephalograph. The results indicated that the automatic activity was quite sensitive to γ radiation; at the same time, it developed resistance against radiation injury as shown by the fact that doses of several 10,000 R were needed to cause serious damage. The mechanism of this reaction seemed to consist in the degeneration of biochemical processes that excited the automatic centers of the heart. The centers were also sensitive toward addition of potassium; removal of potassium from the cells under the influence of radiation could play an important role in the reaction of hearts to radiation. (TTT)

31133 BLADDER COMPLICATIONS AFTER RADICAL ABDOMINAL HYSTERECTOMY WITH LYMPH NODE RESECTION AND POSTIRRADIATION. FOLLOW-UP ON 89 PATIENTS. Schmid, I.; Baumann, U. (Univ., Zurich). Geburtsh. Frauenheilk., 27: 954-69(Oct. 1967). (In German).

Bladder function was studied in 89 patients who received x ray and Ra treatment seven to ten weeks postoperatively for cervical carcinoma. Three weeks to ten yr later, follow-up examination was conducted by interview, cystoscopy, cystonometry, and sometimes sphinctertonometry and testing of the thermosensitivity. The tonometric index usually rose to a maximum three weeks after surgery, fell to about half the initial value before irradiation, then rose slightly during and after irradiation. It then followed a progressively downward course. The typical tonometric curve appeared to be caused by a decrease in elasticity due to pancystitis that initially masked the signs of an atonic neurogenic bladder. Testing of the thermosensitivity appeared to be valuable in investigating denervation of the bladder. Restoration of the bladder function as concerns micturition was found to occur concomitantly with a reappearance of bladder sensitivity and could be due to the regeneration of the resected bladder nerves. A mild type of stress incontinence was frequently found. (BBB)

31134 BRAIN SCANNING IN NEURO-OPHTHALMOLOGIC DIAGNOSIS. Henderson, John Woodworth; Antine, Bartley E. (Univ. of Michigan, Ann Arbor). Amer. J. Ophthalmol., 62: 1076-88(Dec. 1966).

Use of ^{197}Hg-, ^{203}Hg-, and ^{99m}Tc-labeled compounds for detection of neuro-ophthalmologic disorders are contrasted, on the basis of their physical characterics, radiation doses received from them, and scanning effectiveness. With ^{203}Hg-Neohydrin, the half life of the isotope is 45 days, although with rapid renal excretion the whole-body biologic half-life is only eight hr. However, retention of 10% of the dose in the kidney with a biologic half-life of 28 days delivers undesirable renal radiation. This can be countered in part by the routine administration of Mercuhydrin intramuscularly 24 hr prior to injection of the radioisotope. The renal sites of binding are blocked and the dose of radiation is reduced three-fold in most patients. The ^{197}Hg-labeled Neohydrin (half-life of 65 hr) has the advantage of reducing the amount of renal radiation and makes the blocking dose of Mercuhydrin unnecessary. The amount of ^{197}Hg usually given intravenously is 15 μCi/Kg of body weight, with the optimal time for scanning 25 hr after injection. It is possible to rescan the patient following this single dose as long as 48 hr after administration. Recent improvements have included the use of ^{99m}Tc with color photoscanning. Technetium-99m has a half-life of six hr and emits a γ ray in passing to its ground state. A dose of 10 mCi is given intravenously, and the scanning begun 1.5 hr after injection. A scan can be completed in 15 min per view. An oral dose of 200 mg of potassium chloride is given 10 min before the ^{99m}Tc injection to block the thyroid gland from uptake. Some clinical examples are cited to demonstrate the advantages available to the clinician in the use of brain scanning for neuro-ophthalmologic diagnosis. This relatively innocuous technique may spare the patient other types of examinations that are potentially more dangerous. (BBB)

31135 CARE OF RADIATION CASUALTIES. Blakely, J. London, Heinemann, 1968. 139p. 30s.

Chapter headings are as follows: Introduction; simple physics, units and measurement; effects of radiation on the body and radiation protection; the acute radiation syndrome; radiation and the skin; internally deposited radioactive material (internal contamination); late effects of irradiation; contamination and decontamination; first aid, rescue and transport; protective clothing and equipment; public relations. (UK)

31136 CONDITIONS AFFECTING THE INHIBITORY ACTION OF RLP ON RADIATION LEUKEMOGENESIS IN MICE. Berenblum, I.; Trainin, N.; Cividalli, G.; Boiato-Chen, Louise; Knyszynski, Ahuva (Weizmann Inst. of Science, Rehovoth, Israel). Tumori, 53: 5-18(1967).

The inhibitory effect of RLP (radiation-leukemia protection factor, in a cell-free extract derived from sheep spleen) on radiation leukemogenesis in mice, was studied under different biological conditions to determine the limitations and specificity of its action. For inhibition of radioinduced leukemogenesis (lymphatic, thymic type) in C57BL/6/Jax mice, the RLP injections had to be given repeatedly (at least four times for demonstrable effect, and 10 times for optimal effect) when the treatment was begun about one hr after irradiation. Weaker effects were obtained when the treatment was begun 24 hr after irradiation, and no inhibition was seen when the injections were given before the start of the radiation treatment, or begun two weeks after its completion. In irradiated RF mice, RLP inhibited the induction of lymphatic (thymic) leukemia, while that of myelogenous leukemia appeared to be augmented. RLP failed to inhibit the spontaneous development of lymphatic (thymic) leukemia in AKR mice. The results indicated that the inhibitory action of RLP was an antiradiation effect with respect to leukemogenesis, rather than an antagonism against the leukemogenic process proper. (BBB)

31137 CONTROL OF RADIATION SENSITIVITY WITH VITAMIN B_6. Ladner, Hans-Adolf (Univ., Mainz). Hippokrates (Stuttgart), 37: 769-74(Oct. 15, 1966). (In German).

The biological characteristics of vitamin B_6, some effects of whole-body irradiation and localized irradiation, and the role of pyridoxine and pyridoxal phosphate as shown in animal studies are discussed. The survival rate of male rats 30 days after whole-body x irradiation with a dose of 955 R, given 15 or 25 mg/animal of pyridoxine-HCl five min before irradiation, was zero. Pyridoxamine given under the same conditions was also completely ineffective. When pyridoxal-5-phosphate was given at doses of 12.5, 15, and 25 mg/animal five min before irradiation, survival rates were 70, 24, and 28%, respectively. The highest rate of survival was observed when the pyridoxal-5-phosphate was given intravenously instead of intraperitoneally. When it was given intraperitoneally 45 min before irradiation at a dose level of 25 mg/animal the survival rate was only 9%. Only 5% of dogs exposed to 400-R x irradiation survived for 30 days. The survival rates when pyridoxal-5-phosphate or pyridoxine was administered were 83 and 20%, respectively. Various possible mechanisms that may be related to these findings are discussed. (BBB)

31138 ^{131}Ce PHOTOSCAN. AID IN THE DIAGNOSIS OF MYOCARDIAL INFARCTION. **McGeehan, John T.; Rodriguez-Antunez, Antonio; Lewis, Royston C. (Cleveland Clinic Foundation). J. Amer. Med. Ass., 204: 585-9(May 13, 1968).**

Nine patients with clinical studies leading to positive diagnoses of myocardial infarction had findings on ^{131}Cs photoscans suggestive of perfusion defects of the myocardium. In eight of nine photoscans, the sites of the defects correlated well with the locations indicated by the electrocardiograms and coronary arteriograms. Four patients with clinical studies indicating no evidence of myocardial infarction had no findings on the photoscans suggestive of localized perfusion defects. The myocardial photoscan made after injection of ^{131}Cs-cesium chloride appears to be a valuable adjunctive study to evaluate old or recent myocardial infarction. (auth)

31139 CELLS CULTURES OF HAPLOPAPPUS GRACILIS AS TESTING MATERIAL FOR RADIOMIMETIC COMPOUNDS. **Eriksson, Tage (Univ. of Uppsala). Hereditas, 57: 127-48 (1967).**

The effect of five different radiomimetic compounds on the chromosomes of *H. gracilis* cultivated in vitro was studied. To make a comparison of the data with those of *Vicia faba* the amounts of nucleic acids and protein were estimated in *H. gracilis*, since DNA content and nuclear volume were correlated in some species of plants, and the average DNA content per diploid nucleus or per chromosome was highly correlated with radiosensitivity. The possibility of a similar correlation between DNA content per cell and sensitivity of radiomimetic compounds was considered. All compounds tested gave a lower frequency of abnormal cells with cultivated cells of *H. gracilis* than that obtained in Vicia experiments, indicating that the cells were more resistant. It was perhaps necessary for a plant with only four chromosomes to possess a high resistance to be able to survive. The chromosomes and the DNA of *H. gracilis* were, however, as sensitive as those of *V. faba* if the chromosome number and the amount of DNA per cell were included in the calculations. (BBB)

31140 CHEMOTHERAPY AND RADIATION THERAPY OF MALIGNANT BRAIN TUMORS IN OUR CLINIC. **Mori, Kazuo; Handa, Hajime; Onoyama, Yasuto (Kyoto Univ). No To Shinkei, 19: 326-31(Apr. 1967). (In Japanese).**

Results of 285 cases of brain tumors treated with radiation from 1955 to 1964 were presented. In the glioblastoma group irradiation following surgery increased longevity markedly. In chromophobe adenoma improvement of visual function was greater in the group treated with surgery and subsequent irradiation as compared with that treated with surgery alone. Radiation therapy alone was not equally as effective as combined therapy. More favorable results were obtained in the group that received less than 6000 R of tumor dose as compared to the group that received more than 6000 R. (BBB)

31141 CONSTRICTIVE PERICARDITIS FOLLOWING RADIATION THERAPY. **Muggia, Franco M. (Albert Einstein Coll. of Medicine, New York); Cassileth, Peter A. Amer. J. Med., 44: 116-23(Jan. 1968).**

The relation of irradiation to pericardial disease is discussed. Constrictive pericarditis resulted from irradiation with 179-R daily doses of 2-MeV x rays for carcinoma of the esophagus. An episode of acute pericarditis was observed nine months after completion of radiotherapy, followed shortly by a pericardial effusion and subsequently by signs and symptoms of constrictive pericarditis. A successful pericardiectomy was performed 14 months after irradiation. The patient showed no recurrence of the malignancy or of congestive heart failure. It was suggested that for most patients treated with conventional doses of radiation to thoracic structures the risk of pericardial disease was probably slight, and continuation of such treatment in the face of minimal changes seemed warranted. Patients receiving prophylactic radiotherapy for lymphoma or seminoma and those given radiation over internal mammary nodes or locally for carcinoma of the left breast require more careful consideration as to the need for such therapy, and the dose and method of administration. (BBB)

31142 CONTRIBUTION TO THE TREATMENT OF SKIN CARCINOMA RECURRENCE FOLLOWING X-RAY IRRADIATION. **Limberger, S.; Dietz, H.; Boepple, D. (Staedtische Hautklinik, Stuttgart). Dermatol. Wochenschr., 152: 201-8(Feb. 26, 1966). (In German).**

The combinations of surgical and irradiation treatment used to treat and repair recurrent cases of basiliomas, spinaliomas, and squamous cell carcinomas induced by prior x irradiation treatments are described. Some of the patients had lupus vulgaris, for which they were x irradiated, others were irradiated one or more times with about 5000 R of Chaoul irradiation. In some cases, the irradiations were performed as long as 30 or 40 yr previously, but in others the recurrences had appeared within one year after the irradiation. In all cases extensive plastic surgery was required in order to produce satisfactory results. The relations of radiological and plastic surgical measures to treatment of skin carcinomas in general, and in particular to the problems presented by the recurrence of carcinomas induced by previous x irradiation are briefly discussed. The therapeutic outcome of eight cases was described in the text and illustrated by photographs. (BBB)

31143 CHEMICAL PROTECTION OF THE STRUCTURE-GENERATING PROPERTIES OF NUCLEOPROTEINS AGAINST THE EFFECTS OF IONIZING RADIATION. **Pisarevskii, A. N.; Andrianov, V. T.; Krot, V. I. (Belorussian State Univ., Minsk). Dokl. Akad. Nauk BSSR, 11: 538-40(June 1967). (In Russian).**

Following up earlier studies on the radioprotective properties of desoxyribonucleoproteins, a nucleoprotein with an N/P ratio of 3.7 was irradiated at a dose rate of 100 R/min. Protective agents, such as sulfur-containing materials, indolyl alkylamine (tryptamine), nitriles or gallates were added to the nucleoprotein solution, using concentrations of 0.01*M* and adding also a 0.05*M* phosphate buffer solution. Under the experimental conditions used, the critical dose of 500 R was close to the usual dose encountered in animal experiments. The results revealed that the sulfur-containing compounds and gallates exerted the highest protective action. A definite correlation could be established between the protective ability and the chemical structure of the agent: indol derivatives with slightly polar substitution groups in the fifth position exhibited the highest protective action; substitution in other positions or use of polar compounds resulted in a steep decrease of the protective effect. In the case of gallates, the effect was enhanced by increasing the length of the alkyl group. The concentration of the agents was also an important factor. (TTT)

31144 DIGITAL COMPUTER SIMULATION STUDY OF THE RADIO-HIPPURAN RENOGRAM. **Horgan, J. D. (Wood Veterans Administration Hospital, Milwaukee); Meade, R. C.; Madden, J. A.; Torzala, T. A. Int. J. Appl. Radiat. Isotop., 18: 797-808(Dec. 1967).**

A digital computer model of the radio-Hippuran renogram was developed to simulate the normal renogram previously described. The parameters used correspond to previously established physiologic values whenever such data were available, e.g., plasma volume, effective renal plasma flow, renal transit time, and cardiac output. The apparent Hippuran space and body background were determined from patient studies. Intercompartmental transfer and intra-renal mixing rates were of necessity computer derived from the best fit. The model gives an estimate within ±5 percent of the mean normal renogram and the 30-min excretion. Model results do not correspond as closely to the apparent Hippuran space. A simultaneous good fit of all three results does not appear possible with any combination of parameters which differ greatly from the values used. The model successfully simulates disease states, such as reduction in renal blood flow, mechanical obstruction, and renal artery stenosis. (auth)

31145 DOSE DETERMINATION FOR ^{60}Co TELETHERAPY BY THE DECREMENT LINE METHOD. **Schoknecht, G.; Klatt, A. (Physikalisches Laboratorium, Berlin. Hahn-Meitner-Institut fuer Kernforschung, Berlin). Biophysik, 4: 77-86(1967). (In German).**

The value of the dose rate in a stationary field can be represented as a product of a dose rate value in air, the tissue-air ratio, and the relative field distribution. The relative field distribution can be determined from the dose distribution along two characteristic lines using the decrement lines. The calculation of the stationary field distribution is made by application of an analytical representation for the dose distribution along the central beam and experimental data in the direction perpendicular to it. The calculation program yields both the dose plane that serves for the determination of the absolute dose data and also suitable normalized distributions. The representation of the results in the form of isodoses is possible by expression of the dose intervals given with unit pressure symbols. (tr-auth)

31146 EVALUATION OF THE METHODS OF CONVENTIONAL ROENTGENOTHERAPY IN TREATMENT OF NASOPHARYNGEAL CAVITY NEOPLASMS. **Skowronski, Stefan; Skowronska, Irena; Jach, Krzysztof; Skommer, Grazyna. Nowotwory, 17: 257-62(July-Sept. 1967). (In Polish).**

Treatment of patients (35) with naso-pharyngeal cavity neoplasms exclusively with x rays in County Oncological Center (Poznań) resulted in 22.8 percent of five-year survival. Attempts to evaluate the methods of conventional roentgenotherapy in treatment of nasopharyngeal cavity neoplasms are described. This evaluation was based on doses measured in a special anatomic phantom of the head. (auth)

31147 EFFECT OF ECDYSONE ON THE PUPARIUM FORMATION IN IRRADIATED EPHESTIA KUHNIELLA Z. **Kuzin, A. M.; Kolomiitseva, I. K.; Yusifov, N. I. (Inst. of Biological Physics, Moscow). Nature (London), 217: 743-4(Feb. 24, 1968).**

Complete inhibition of metamorphosis and pupa formation is observed in some insect species on irradiation with γ- and x-rays to >20 kR, and puparium formation is delayed in Ephestia kühniella by doses of 20 to 30 kR. Inhibition of pupation might be explained by radiation damage to the hypodermis nuclei and the inability of DNA to give any new genetic information. It might also be caused by a disturbance of neurosecretory cell activity and the absence of ecdysone. In the studies described the effect of injected ecdysone on puparium formation in irradiated larvae was investigated. It was found that injection of an ecdysone preparation did, in fact, induce puparium formation in irradiated insects, leading to the conclusion that absence of puparium formation in the irradiated larvae results from the absence of ecdysone, this absence resulting from irradiation damage to the neurosecretory cells. (UK)

31148 EFFECTS OF VARYING ^{10}B DOSE, THERMAL NEUTRON FLUENCE AND REACTOR EMPLOYED ON RESULTS OF NEUTRON CAPTURE THERAPY OF A TRANSPLANTABLE MOUSE NEOPLASM. **Farr, Lee E.; Konikowski, T. (Univ. of Texas, Houston). Int. J. Appl. Radiat. Isotop., 19: 459-70(May 1968).**

Data are presented comparing results from neutron capture therapy of a transplantable mouse neoplasm after doses of boron-10 equivalent to 25, 35, and 50 micrograms per gram body weight at comparable thermal neutron fluences; data are also presented comparing results with three differently designed nuclear reactors. In addition, in two of the studies to provide an extension of control data, data are presented of results obtained at very low thermal neutron fluences. Comments and data cover borate distribution among blood, neoplasm and muscle with a discernibly different pattern emerging at the higher boron dose, compared to the lower. The data reported are on 627 animals bearing neoplasms. From 50 to 79 percent of treated animals, depending upon the specific study, showed complete and permanent (lifetime) regression of the neoplasm. (auth) (UK)

31149 FACTITIAL PROCTITIS DUE TO IRRADIATION FOR CANCER OF THE CERVIX UTERI. **Quan, Stuart H. Q. (Memorial Hospital, New York). Surg. Gynecol. Obstet., 126: 70-4 (Jan. 1968).**

Sixty-five patients diagnosed to have radiation injury to the rectum were studied. Fifty-two of these had received radiotherapy for epidermoid cancer of the cervix uteri. Precise correlation between dose of irradiation and resultant degree of factitial proctitis could not be determined. In the group with cancer of the cervix uteri, mild rectal changes developed in 17 cases. Operative intervention was nevertheless required for eight. Of the 33 patients who showed advanced changes of factitial proctitis, 29 required surgery. In two additional patients whose epidermoid cancers of the cervix were successfully irradiated, new primary adenocarcinoma of the rectum developed 18 and 21 years later. Irradiation injury to the bladder and small intestine was noted in ten and eight patients, respectively. Six patients died as a direct or indirect result of irradiation injury to the extragenital organs in the pelvis. (TSS) (BBB)

31150 HEMORRHAGIC TYPE OF DIABETIC RETINITIS: TREATMENT WITH HYPOPHYSECTOMY OR PROTON IRRADIATION AT THE BRAGG PEAK. **Sweet, William Herbert (Massachusetts General Hospital, Boston). No To Shinkei, 19: 12-18(Jan. 1967). (In Japanese).**

For the treatment of the hemorrhagic type of diabetic retinitis, hyphophyseal stalk section and proton irradiation utilizing the Bragg Peak were described. Proton irradiation had some advantages over x-ray treatment in that it could be focused precisely on the local area with little destruction of other tissues. The scatter of heavy protons was less than for x rays and the transfer of its energy was greater. In irradiation of the hypophysis, the proton beam was generated in a cyclotron and passed through the left side of the patient's head. The adjacent tissues were protected to prevent unwanted irradiation. Of 138 cases of diabetic retinitis subjected to proton irradiation therapy of the hypophysis, 91% showed decreased pituitary function and 9% of the cases normal function. Among the 91%, 71% showed an improvement in vision and 25% showed improvement in the group with normal function. Thus, both hypophyseal stalk section and proton irradiation utilizing the Bragg Peak were considered to be effective in the treatment of diabetic retinitis. Both methods led to improvement in vision or the maintenance of vision where it might otherwise have been lost. (BBB)

31151 IMPAIRED SKELETAL DEVELOPMENT FOLLOWING X-RAY OR RADIUM IRRADIATION AT AN EARLY AGE. **van Nes, C. P. (Orthopedische Kliniek en Ongevalsziekenhuis, Alblasserdam, Netherlands). Ned. Tijdschr. Geneesk., 110: 1904-11 (Oct. 22, 1966). (In Dutch).**

A radiographic study is reported on 15 cases of seriously impaired bone growth in patients who were given x ray or Ra therapy during childhood. The changes consisted of shortening and deformation of bones and development of local tumors. Only one patient was irradiated for a malignant condition (lipoangiosarcoma). The other 14 cases were treated for benign neoplasms (hemangioma). These observations led to the conclusion that extreme caution was necessary in applying x ray or Ra therapy for tumors in young children. In benign tumor cases other forms of treatment should be applied. This view was corroborated by the conclusions that may be drawn from other case reports and experimental studies reported in the literature in the last 20 yr. A brief case report is presented for each of the 15 cases, along with illustrations of bone radiographs. The pertinent clinical and experimental literature is reviewed. (BBB)

31152 INTRACAVITARY RADIUM THERAPY OF BLADDER TUMORS. **Sell, Arne (Radium Centre, Odense, Denmark). Danish Med. Bull., 14: 21-6(Jan. 1967).**

In 36 of 50 patients treated with Ra, temperature rose to between 38°C and 39°C for two to five days, and in half of the patients this was accompanied by a urinary tract infection. Neither vesical nor rectal tenesmus was seen during the treatment. Urethral stricture was seen in four patients. Temporary cystitis, possibly with superficial necrosis or ulceration, was observed in eight patients, and in five patients with tumor residue or relapse. Severe bladder sequelae including contracted bladder and severe incrustations or calculi were seen in ten patients. The cases varied in severity. In four cases these complications occurred in connection with the tumor residue or relapse and only one of these patients was alive five yr after treatment. Most of these sequelae occurred within the first yr after treatment and only once did contracted bladder occur four yr after treatment without the patient having had any symptoms in the previous yrs. Frequency of sequelae in patients treated surgically immediately prior to Ra treatment was not greater. (BBB)

31153 IRRADIATION IN TWO SERIES AND PREOPERATIVE IRRADIATION IN TWO DAYS (PRELIMINARY RESULTS IN 140 CASES). **Dutreix, J.; Schlienger, M.; Le Peigneux, M. (Institut G.-Roussy, Villejuif, France). J. Radiol., Electrol., Med. Nucl., 48: 167-72(Mar.-Apr. 1967). (In French).**

A method for the fractionation of the dose of supervoltage x radiation used for the pre-operative treatment of neoplasms is presented. The dose fractionation scheme is based on the biological hypothesis that the first series will result in rapid destruction of the radiosensitive part of the tumor population. The rest interval is given in order that the cells involved can disappear, and so that the environmental conditions of the remaining tumor can be reorganized so as to be sensitive to the action of the second series. This mode of fractionation makes possible irradiation without the necessity of postponing the surgery. The reduction in the number of sessions and in the duration of hospitalization is an appreciable advantage, particularly in the case of palliative irradiations. A preliminary study was made on 140 patients in order to evaluate radiation tolerance. The irradiation schedule was shown to be acceptable even for patients in very poor condition with very extensive tumors. (J.S.R.)

31154 LATE MORTALITY IN MIDLETHALLY IRRADIATED MICE GIVEN INJECTIONS OF HEMATOPOIETIC CELLS FROM F$_1$ HYBRIDS. **Allegretti, N. (Univ., Zagreb. Rudjer Boskovic Inst., Zagreb). J. Nat. Cancer Inst., 40: 431-40(Mar. 1968).**

Bone marrow or spleen cells of A, CBA, or (CBA × A)F$_1$ mice were injected into midlethally (550 R) and lethally (900 R) irradiated CBA mice. Unlike mice not given injections, midlethally irradiated CBA mice given injections of A or (CBA × A)F_1 hybrid cells had a characteristic increase in mortality between 22 and 90 days after irradiation. The gross and microscopic findings, especially in the lymphoid organs, were similar to those in secondary disease, although a graft-versus-host reaction could be ruled out when F_1 cells were injected. Lymphoid atrophy was invariably observed in the dead mice, just as in secondary disease, and is believed to be the factor responsible for death. It is suggested that allergic death of reacting cells is one of the mechanisms that led to the lymphoid tissue atrophy. (auth)

31155 LONG-RANGE PROGRAM FOR THE APPLICATION OF RADIOISOTOPES AND RADIATION IN JAPAN. Muto, Toshinosuke (Japan Atomic Energy Commission, Tokyo). Isotop. Radiat. Technol., 5: 334-6(Summer 1968).

The part of the program concerned with the application of radioisotopes and/or radiations in medicine, biology and agriculture, industry, radiation chemistry and food irradiation, and the production and distribution of radioisotopes is briefly summarized. (B.S.L.)

31156 MODIFICATION OF THE GAMMA-THERAPEUTIC UNIT FOR STATIC IRRADIATION. Sul'kin, A. G.; Kondrashov, V. M. (All-Union Scientific-Research Inst. of Radiation Techniques, Moscow). Med. Radiol., 12: No. 10, 78-82(Oct. 1967). (In Russian).

Results of clinical and radiophysical investigations of the modified ^{60}Co apparatus for 850 equivalent/radium are presented. The curves of isodose distribution for fields measuring 5 × 5 and 6 × 9 cm, in the source-phantom surface distance equalling 50 cm and irradiation fields of 8 × 10 and 10 × 14 cm, with the distance between the source and phantom surface amounting to 60 and 75 cm respectively, are given. There were noted the advantages of the modified apparatus in comparison with GUT-Co-400: the use of a small-size source of radiation with the diameter of the active part being 0.9 cm; it shortens the width of semishadows by 3.5 times and thus sharply reduces the radiation loading on healthy tissues; it increases the radiation output of the source by two times with the simultaneous intensification of protection by 15 to 10 times; it creates favorable conditions for the treatment of patients, correspondingly shortens the durations of contact of irradiation and gives a twofold rise in the capacity of gamma-therapeutic rooms. (auth)

31157 MORPHOLOGICAL STUDIES OF GENITAL GLANDS IN LETHALLY IRRADIATED RATS, RATS PROTECTED AGAINST RADIATION, AND RATS TREATED WITH BONE MARROW. Dimitrov, L.; Krustev, D. (Scientific Research Inst. of Hematology and Blood Transfusion, Sofia). Rentgenol. Radiol., 6: 97-106(1967). (In Bulgarian).

Male and female rats were exposed to a lethal dose of ionizing radiation (800R). On administration to the rats of a radioprotective mixture of AET, MET, and serotonin before irradiation, rat mortality was reduced from 100 to 58.2%. Irreversible morphological changes took place in the genital glands of the animals that survived. Their capacity to bear young was lost. Administration of the mixture of radioprotective agents with antibiotics and bone marrow, or with antibiotics, vitamin B_{12}, and bone marrow reduced the mortality still further and prevented damage to the genital glands of the surviving animals, to the extent that the capacity to bear young was retained. The protective effect on the testicles was less pronounced than on the ovaries. The prophylactic and therapeutic action on the genital system was exerted mainly during the first three to four months after irradiation. (TSS) (JPRS)

31158 NOMENCLATURE FOR TRACER KINETICS. Brownell, Gordon L. (Massachusetts General Hospital, Boston); Berman, Mones; Robertson, James S. Int. J. Appl. Radiat. Isotop., 19: 249-62(Mar. 1968). (BNL-11819).

This report is concerned with the nomenclature, concepts and procedures used in medical tracer studies. It aims at achieving a certain measure of uniformity in their usage. To that effect, it reviews the basic concepts of tracer kinetics and proposes a set of definitions and a unified system of symbols. (auth) (UK)

31159 NUCLEAR MEDICAL LABORATORY METHODS. I. INTRODUCTION TO THE SUBJECT. Oeff, Karl (Freie Univ., Berlin). Med. Lab., 19: 264-5(Nov. 1966). (In German).

Three main groups of nuclear medical methods are discussed. The methods include: scintigraphy to establish organ form, size, and position, or tumor localization; functional studies of hormone production, circulation, and renal function by in vivo measurements; and laboratory methods for activity measurements, separation of blood or tissue components, histological-autoradiographic localization, or in vivo analysis by neutron activation. At present, in vivo measurements and scintigraphic procedures are most widely used, as compared to other laboratory methods. A study of the literature for the period 1960-65 indicates that research in nuclear medicine is developing rapidly. This is an important factor that has great significance for training and education of medical laboratory technologists. (BBB)

31160 ON A CASE OF MANDIBULAR OSTEORADIONECROSIS AND LATE EPITHELIOMA OF THE LIP CAUSED BY RADIUM THERAPY. Bote, D. Vianello (Ospedali Civili Riuniti, Venice). Arch. Stomatol. (Rome), 6: 317-33(Oct.-Dec. 1965). (In Italian).

Necrotizing and malignant changes resulting from Ra treatment for removal of facial hair in a young woman were reported. Radium was applied above the upper lip in five monthly treatments of 24 hr each. The total dose given was not known. Although the hair was transiently removed, hypertricosis recurred and 23 more treatments were given. Six years later dermatitis and a nonhealing ulcer developed. Additional Ra treatments were given. A spinocellular carcinoma was removed from the tongue, and epitheliomas developed on the lower lip. Plastic surgery was performed to remove the radioinjured skin and tumors. Mandibular osteoradionecrosis was also presented and the sequestered bone was excised. The histopathological findings were described and illustrated, and similar cases in the literature were reviewed. (BBB)

31161 OXYGENATION STATUS OF A TRANSPLANTABLE TUMOR DURING FRACTIONATED RADIATION THERAPY. Van Putten, L. M.; Kallman, R. F. (Stanford Univ., Palo Alto, Calif.). J. Nat. Cancer Inst., 40: 441-51(Mar. 1968).

Radiation survival studies are reported for cells from a transplantable solid tumor, sarcoma KHT, in C3H/Km mice. Cells from the tumor were brought into suspension and survival was determined by an endpoint-dilution method. The parameters of the X-ray survival curves for irradiation in vitro in oxygen were D_0 = 115 rad, N = 10.9, and for irradiation in nitrogen D_0 = 357 rad, N = 2.7. The tumor in situ was irradiated in the living animal breathing air and in the dead mouse killed with nitrogen to obtain complete anoxia. The terminal slopes of the dose-survival curves were approximately parallel and it is concluded that the tumor in vivo contains anoxic cells. The fraction of anoxic cells of the tumor in the living mouse was calculated from the distance between the parallel terminal slopes. In tumors that received no previous irradiation, on the average 14% of the cells were anoxic, and for two types of pretreatment with four or five times 190 rad at daily intervals this fraction was 14 and 18%, respectively. These results demonstrated that under fractionated radiotherapy, that is expected to eliminate preferentially the well-oxygenated cells from the tumor, a continuous movement of previously anoxic cells into the compartment of well-oxygenated cells must occur. The implications of these findings are discussed. (auth)

31162 PHYSIOLOGIC AND PATHOLOGIC FINDINGS IN THE USE OF ^{99m}Tc FOR GASTRIC SCINTIGRAPHY. Engelhart, G.; Fridrich, R. (Univ., Basel). Schweiz. Med. Wochenschr., 98: 301-4(Feb. 24, 1968). (In German).

The gastric excretion of ^{99m}Tc ($NaTcO_4$) and the possibility of gastric scanning with it were investigated. Gastric excretion of pertechnetate depended on acidity, as shown by single-dose intravenous injection of 2 mCi $Na^{99m}TcO_4$, continuous aspiration of gastric juice, and stimulation by Histalog (2 mg/Kg body weight). A direct relation was shown to exist between the excretion of Tc and the production of hydrochloric acid. This was demonstrated by continuous infusion of $Na^{99m}TcO_4$, measurement commencing only after a steady state had been established (continuous aspiration of gastric juice, parietal cell stimulation with Histalog). Scanning was started five to seven min after the injection of 2 mCi ^{99m}Tc. In clinical routine it was therefore unnecessary to aspirate gastric juice. In portions of the stomach invaded by neoplasms ^{99m}Tc did not accumulate or accumulated less than in normal tissue. Therefore, gastric malignancies were demonstrated by a simple method not involving discomfort for the patient. In some cases this method was found to be more reliable than barium meals or endoscopic studies. (BBB)

31163 PROPHYLACTIC MEASURES FOR PREVENTION OF CYSTITIS AND OTHER SIDE-EFFECTS OF X-RAY AND RADIUM THERAPY OF FEMALE GENITAL CARCINOMA. Zuercher, W. O. (Univ., Basel). Geburtsh. Frauenheilk., 27: 170-5(Feb. 1967). (In German).

The effects of trihydroxyethylrutoside (THR) on prevention of cystitis, enteroproctitis, and skin reactions produced in the course of treatment of ovarian or uterine carcinomas with x irradiation and Ra therapy were studied. Some of the patients were subjected to surgery along with the irradiation treatments. These patients received four doses of 3000 R each in four fields, plus 1200 to 1800 mg-hr from a Ra implant. Those patients who were not operated on were irradiated in several fields with 900 to 1000 R of x irradiation and Ra implants of 700 mg-hr. The parametrial focal dose was 2600 to 3000 R. The bladder and rectum received 3000 to 5000 R or more. Out of 48 of these patients who were not operated on, but were treated with THR, 13 developed slight cystitis, and three developed more severe cystitis. Out of 46 patients untreated with THR, 10 developed moderate or severe cystitis, and six slight cystitis. Slight enteroproctitis was observed in 12 of the THR group, but two developed severe enteroproctitis. In 12 patients untreated with THR severe enteroproctitis developed, and four showed mild enteroproctitis. Only one THR-treated patient developed a severe skin reaction, and 16 showed slight skin reactions. In the untreated patients, skin reactions were severe in 15, and slight in 11 patients. (BBB)

31164 POSSIBILITIES OF APPLICATION OF THE ANGER SCINTILLATION CAMERA IN PEDIATRICS. Hoefer, R.; Zweymueller, E. (Univ., Vienna). Wien. Klin. Wochenschr., 79: 673-5(Sept. 15, 1967). (In German).

An application of a test to measure the resolving power of the Anger scintillation camera is described. Several examples of the camera's use for scintigraphy with infants and children are presented. Data for the measurement and evaluation of irradiation burden from radioisotopes used for scintigraphy in infants and children are presented. Measurements of the liver for suspected intrahepatic bile duct atresia, using 5 μCi of ^{131}I-Rose Bengal are described. Renal studies using 2 μCi ^{131}I-Hippuran/Kg body wt to measure kidney function, studies of bladder urine retention, cystic enlargement and vesicoureteral reflux using 10 μCi of ^{131}I-Hippuran, and evaluation of massive hydrocephalus using 5 μCi of colloidal ^{198}Au are also described. With the conditions and amounts under which the radioisotopes were used in the infants and children, it was estimated that the irradiation burden received from 15 μCi of Rose Bengal by the inner wall of the small intestine was 8.2 rad. From 6 μCi of ^{131}I the values calculated were 5 Mrad to the kidneys, and 0.05 and 0.12 Mrad to the female gonads from the renal surface and cortex. The calculated dose to the female gonads from 10 μCi of ^{131}I instilled into the urinary bladder was 6 Mrad. (TSS) (BBB)

31165 PRIMARY HEPATOMA 31 YEARS AFTER INJECTION OF THOROTRAST. Akagi, Go; Hizawa, Kazuo; Kitamuro, Tadao; Fukuda, Fukuhei; Yamashita, Satoshi; Tao, Shigeru (Tokushima Univ., Japan). Tokushima J. Exp. Med., 13: 111-19(Nov. 1966).

The occurrence of primary hepatoma 31 years after the injection of Thorotrast in a 51-yr-old patient was reported. Deposits of ThO_2 were demonstrated in the liver, spleen, lymph nodes, bone marrow, and intestine. Radioactivity was demonstrated by radioautography. In the liver, Thorotrast had accumulated chiefly in the portal triad and central vein, and deposition in connective tissue was slight. In the spleen, a large amount of Thorotrast was deposited around the central arteries and trabeculae, and plasma cells had increased in the vicinity of Thorotrast aggregates in the spleen and lymph nodes. Degenerative changes of blood vessels were marked, and both these degenerative changes and development of the hepatoma were considered to be due to internal irradiation by Thorotrast. (BBB)

31166 PROPHYLACTIC EFFECT OF MARINAMYCIN AGAINST IONIZING RADIATION. Soeda, Momoe; Ootomo, Michiko (Japan Defence Agency). Nippon Igaku Hoshasen Gakkai Zasshi, 26: 1208-12(Dec. 1966).

Mice of DD-S strain exposed to 100 to 200 R of x irradiation usually developed leukopenia within one week, while those given Marinamycin two hours before irradiation developed leukocytosis instead of leukopenia. Control mice exposed to 700 R of ^{60}Co γ irradiation could survive for at least 35 days, but the survival rate was 40 to 60%. Mice exposed to 800 R were all dead within 13 days. The survival rate on the 35th day was zero. Marimycin, one new anti-leukopenic agent appreciably enhanced the survival rate of irradiated mice, when given in adequate dose and time. In the present stage of preparation, the dosage ranging from 25 to 50 gamma is thought to be adequate for an adult mouse and the maximum effect is expected when given within two to three days after exposure. (auth)

31167 PREVENTION OF RADIATION-INDUCED CREATINURIA BY INSULIN. Koszalka, Thomas R.; Andrew, Carole L. (Jefferson Medical Coll., Philadelphia). Science, 160: 1112-13 (June 7, 1968).

Insulin completely suppressed creatinuria in rats x irradiated with an absorbed dose of 500 rads. Results indicated that the hormone exerted this effect either by restoring or maintaining the ability of irradiated muscle to take up creatine from the extracellular fluid at a normal rate, or possibly by influencing the synthesis or breakdown of phosphorylcreatine. (auth)

31168 RADIOGRAPHIC TRABECULAR QUANTITATION OF HUMAN LUMBAR VERTEBRAE IN SITU. I. THEORY AND METHOD FOR STUDY OF OSTEOPOROSIS. Rockoff, S. David (Yale Univ., New Haven). Invest. Radiol., 2: 272-89(July-Aug. 1967).

A scanning microdensitometer-analog computer system is described that permits quantitation of radiographically recorded vertically and horizontally oriented trabecular shadows of in situ human lumbar vertebrae. The basis for vertebral trabecular quantitation in the study of osteoporosis was that trabecular bone was metabolically more active than was cortical bone and vertebral trabecular bone appeared to be the most active trabecular bone of the human body in terms of mineral turnover rate. The method for determining the widths and number of radiographically visualized trabeculae was based upon the observation that, when viewed from the lateral projection, the vertically and horizontally oriented trabeculae have a fairly uniform spatial orientation. The method of quantitation yields data that showed reasonable replication and that appeared to reflect the visually assessed character of the trabecular pattern. (auth)

31169 RADIONUCLIDE SCANNING OF THE PLACENTA IN ABDOMINAL PREGNANCY. Curry, George C.; Bonte, Frederick J. (Univ. of Texas, Dallas. Parkland Memorial Hospital, Dallas). J. Amer. Med. Ass., 203: 225-7(Jan. 15, 1968).

Scintillation scanning of the placenta with ^{99m}Tc serum albumin is advanced as an excellent diagnostic technique for safely localizing placental sites in abdominal pregnancy. (auth)

31170 RADIATION EFFECTS AND ADRENAL CORTEX. III. INHIBITION OF CORTICOSTEROID INCREASE BY CYSTEAMINE AFTER WHOLE-BODY IRRADIATION. Flemming, Kurt (Univ., Freiburg i. B.); Geierhaas, Bruno. Int. J. Radiat. Biol., 13: 13-19(1967).

Previous investigations in rats demonstrated a biphasic increase of the corticosteroid levels both in the adrenal glands and the blood after whole-body x irradiation. The first increase occurred 2.5 hours and the second increase 72 hours after irradiation. Both these phases of increased corticosteroid production and secretion were significantly inhibited by cysteamine. This radioprotective effect was basically the same after mid-lethal and totally lethal radiation doses. It was concluded that both the first and second corticosteroid reaction are specific effects of irradiation. Cysteamine by itself caused an increase of the plasma corticosteroid levels 2.5 hours after injection, while the levels in the adrenal gland remained unchanged, and 72 hours after irradiation this effect of cysteamine could no longer be demonstrated. The possible mechanisms of action of cysteamine are discussed. It is suggested that its radioprotective properties mitigate a stress reaction of the pituitary–adrenal system occurring shortly after irradiation. (auth)

31171 RADIOTHERAPY AND CYTOSTATIC THERAPY OF RHABDOMYOSARCOMA IN THE EAR-NOSE-THROAT AREA. Krueckemeyer, K. (Stadedtische Krankenhaus, Berlin-Neukoelln, Ger.). Monatsschr. Ohrenheilk. Laryngo-Rhinol., 99: 442-8 (1965). (In German).

The results obtained in a five-yr-old patient with rhabdomyosarcoma in the pararetropharyngeal area by treatment with ^{60}Co γ irradiation and the cytostatic agent Trenimon were reported. The irradiation series consisted of eight treatments with ^{60}Co administered over a period of four weeks. The patient died soon afterwards. The morphological effects observed in the tumor cells were not specific with respect to the two types of treatment, and the tumor was not completely destroyed. Frequently, the tumor cells destroyed were replaced only with nonfunctioning scar tissue cells. There could have been some lengthening of life resulting from the combined treatments, but it was not correlated with the histomorphology of the blastoma. Similar results were observed in other reported cases. It was concluded that recovery from this type of tumor could only be obtained by radical surgery. Combined irradiation and cytostatic treatment was justified only in advanced stages of the tumor, where it would be only partially successful. (BBB)

31172 ROLE OF SULPHUR IN RADIOPROTECTIVE EXTRACTS OF MICROCOCCUS RADIODURANS. Serianni, R. W.; Bruce, A. K. (State Univ. of New York, Buffalo). Nature (London), 218: 485-7(May 4, 1968).

It is stated that a highly efficient radioprotective agent, capable of protecting relatively sensitive strains of bacteria such as E. coli B/r against the lethal effects of x-irradiation, can be extracted from *Micrococcus radiodurans*, and there is evidence that the radioprotective components in such extracts may not be sulphydryl in character. In studies with cultures of *Micrococcus radiodurans* grown with only two sources of sulphur available (inorganic sulphate and methionine) extracts contained <3% of the free sulphydryl present in a 32 mM solution of mercaptoethylamine (MEA), yet afforded better protection than MEA. On a weight basis the results suggested that if the radioprotective component is a sulphydryl compound it is much more efficient than MEA, or that it is nonsulphydryl in nature. No evidence was found for the presence of MEA or MPA (mercaptopropylamine). Extracts from stationary phase cultures, whilst highly radioprotective, were apparently devoid of components containing sulphur which could contribute to the radioprotective fraction of the extract, favouring the non-sulphydryl hypothesis. (UK)

31173 REACTION TO ETHER ANESTHESIA IN ANIMALS IRRADIATED WITH PRELIMINARY USE OF SOME RADIOPROTECTIVE AGENTS. **Lazovskaya, A. V.; Bogatyrev, A. V. (Central Roentgen-Radiation Scientific Research Inst., Leningrad). Farmakol. Toksikol., 31: 95-7(Jan.-Feb. 1968). (In Russian).**

Animals subjected to 500- or 616-R doses of x radiation without prior treatment with chemical radioprotective agents demonstrated more rapid advance of ether-induced narcosis, as well as its greater depth and longer duration. Also noted was a reduced or complete lack of excitation period; moreover, a deep (surgical) narcosis with a toxic period that induced irreversible paralysis of the spinal nerve centers was noted. The radiation sickness weakened the resistance to ether in the brain and the spinal cord and narrowed considerably the latitude of the effect of ether. The animals (cats and mice) that received various doses of 5-methoxytryptamine and *S*, β-aminoethylisothiuronium prior to irradiation demonstrated an increased sensitivity to narcosis. In the experiments on mice, in which both agents were administered in doses providing effective radiation protection, 5-methoxytryptoamine failed to reduce the increased sensitivity to ether, while the mice treated with *S*, β-aminoethylisothiuronium showed (at the height of the radiation sickness) significantly decreased sensitivity to ether. The cats treated with individual doses of 5-methoxytryptamine and *S*, β-aminoethylisothiuronium (or in combination with 5-methoxytryptamine) demonstrated reduced sensitivity to ether analogous to that seen in mice. (BBB)

31174 RADIATION CARIES: A RESTORATIVE APPROACH IN THE TERMINAL CANCER PATIENT. **Haas, Charles D. (Monefiore Hospital, Bronx, N. Y.). Ann. Dent., 26: 83-6(Sept. 1967).**

Injury to the teeth during radiotherapy of the oral region and its treatment in patients dying of cancer are illustrated with reference to a case history. A 42-yr-old married female, undergoing radiation therapy for a transitional cell carcinoma of the nasopharynx, showed upon clinical and radiographic examination extensive dental decay. Her dentition showed little clinical crown, with all her mandibular teeth decayed to the gingiva. Prior to treatment she possessed both maxillary central incisors, lateral incisors, cuspids, and first premolars. The mandibular arch had both central incisors, lateral incisors, cuspids, first premolars, and a right second premolar. She had received 6500 R to the right and left lateral nasopharynx, and complained of difficulty in swallowing, poor taste in her mouth, xerostomia, and had evidence of slight trismus. There was no evidence of necrosis. Before radiotherapy, her oral hygiene was fair. The policy of the radiotherapy department was that only diseased teeth, or those that would interfere with treatment, be extracted. This, however, was a controversial point among clinicians. Since there was no immediate indication of possible dental infection, her teeth were retained during therapy. After treatment, diminished blood supply to the alveolus and mucosa necessitated dental treatment, as follows. After complete caries excavation of the maxillary dentition, pathologic exposures were found in both cuspids. Endodontic therapy was instituted; after completion, posts of heavy gauge stainless steel wire were cemented into the root canals, and acrylic crowns fabricated. Copper bands were cemented on all teeth, and root canal therapy started. Then stainless steel wires were cemented into the root canals, and an acrylic splint fabricated. Partial prosthesis was not used in either arch. It was avoided because the added pressure to the ridges might introduce an osteoradionecrosis. The results were satisfactory. (BBB)

31175 RADIATION HYGIENE AND PRACTICE IN DENTISTRY. V. **J. Amer. Dent. Ass., 76: 602-3(Mar. 1968).**

To avoid unnecessary x ray exposure to patients and office personnel, recommended radiation practice includes properly collimated, filtered, and controlled x-ray machines that produce diagnostic films with a minimum amount of irradiation beyond the field of interest. The individual dentist must know how to keep radiation exposure to the lowest possible level consistent with diagnostic requirements and feasible clinical techniques. For maximum protection of the patient and office personnel, the operator should follow proper processing and viewing techniques, that are outlined here. The room used for x-ray film processing should be light tight. The darkroom should be free of dust and dirt, that may have an adverse effect on the film and the processing solutions. A safelight with a Wratten Series 6B filter and a 7.5 W bulb should be placed four ft above the surface of the film stripping table. Developing time should be six min at 68 ± 1°F to produce radiographs of the highest diagnostic quality provided that the correct exposure was made. If developing time is inadequate, much of the latent image is not revealed. Films with poor images must be retaken, exposing the patient to unnecessary radiation. Films that are too light are caused by insufficient exposure, inadequate output of x rays, underdevelopment, or cold or weak developer. To obtain the most information from a radiograph, the film should be dry when viewed, always with a viewbox and never by holding films up to window light or to the operatory light. (BBB)

31176 RADIATION THERAPY WITH HYPERBARIC OXYGENATION. **Churchill-Davidson, I. (St. Thomas Hospital, London). pp 643-7 of Proc. Third Intern. Congr. Hyperbaric Medicine, Duke Univ., Durham, N. C., Nov. 17–20, 1965. Washington, National Academy of Sciences, 1966.**

Patients received a maximum tissue dose of 3500 to 3750 Rads in six treatments over 18 or 19 days. Most were treated while conscious, breathing oxygen at 3 atm. If anesthetized, they breathed oxygen at 4 atm (44.1 psi). The one serious complication resulting from hyperbaric oxygen combined with radiotherapy was radionecrosis of the laryngeal cartilage, usually appearing six to nine months after treatment. This occurred in 16 of 96 patients whose larynx was irradiated. Cartilage in other sites was unaffected. The necrosis was at least partially due to the use of oxygen, as no necrosis occurred in 36 patients treated with a similar dose in air. A small dose reduction eliminated this complication without reducing the tumor sterilization rate. (BBB)

31177 RADIOTHERAPY: ART AND SCIENCE 1965. **D'Angio, G. J. (Univ. of Minnesota, Minneapolis). J.-Lancet, 87: 256-8(July 1967).**

High-velocity heavy particles have geometric and radiobiological advantages over electromagnetic (em) radiations. The edges of a heavy charged particle beam are extremely sharp with little side scatter into the surrounding medium, allowing far better collimation of the beam. The dose rises steeply in the terminal portion of the beam to a peak, after which it drops abruptly within mm or less to zero. The depth dose is higher than that on the surface, and the dose in tissue deep to the point of interest can be reduced to zero. The ionization produced is more effective biologically under certain conditions than a similar dose of em radiation. Beams are also relatively O_2 independent in their effects. Under idealized clinical conditions, not obtainable as yet, beams of this type would be used to deliver high depth doses to small volumes with minimal irradiation of tissues above, below, or beside the locus of interest. These high depth doses would have a high biological efficiency, rendered even higher by reduction of the O_2 effect and, in fractionated treatments, obliteration of cellular recovery after fractionated doses. (BBB)

31178 RADIATION HYGIENE AND PRACTICE IN DENTISTRY. IV. **J. Amer. Dent. Ass., 76: 363-5(Feb. 1968).**

Recommendations for reducing patient and personnel irradiation are made on the basis of exposure control factors and timers in relation to use of high-speed film. Use of the fastest film available. Request film of a USASI (USA) Speed Group rating of "D" or faster. Use only a collimated x-ray machine so that the circular beam striking the skin is not more than 2.75 in. dia. Further restriction of the beam can be obtained by rectangular collimation. If cone cutting occurs, practice proper aligning. Make sure that x-ray machine contains filtration of 2 mm of Al equivalent if operating at less than 70 KVp and 2.5 mm of Al equivalent if operating at 70 KVp or above. Use shielded open-end cones to reduce scatter radiation. Use leaded aprons on children and all patients in the reproductive age range to prevent irradiation of the gonads. Use film holders, bitetabs, or other methods to position film during exposure. The dentist or assistant should never hold a film in place for a patient. Have periodic radiation surveys made of the dental office. Properly expose the x-ray film. Overexposure with underdevelopment subjects the patient and office personnel to unnecessary radiation. (BBB)

31179 RADIATION TREATMENT OF CANCER OF THE PHARYNX: WITH SPECIAL REFERENCE TO TELECOBALT THERAPY. **Lederman, M.; Mould, R. F. (Royal Marsden Hospital, London). Brit. J. Radiol., 41: 251-74(Apr. 1968).**

The possible influence of the structure and anatomical relations of the pharynx on the spread and radiosensitivity of its tumors is discussed. The technique of treating pharyngeal tumors by telecobalt therapy, with special reference to the nasopharynx, is described. For squamous carcinomata of the nasopharynx, a three-phase treatment plan is indicated, in which the primary receives 6,000 rad in six weeks during phases I and II, and the lymph nodes 4,800 to 5,400 rad. In phase III the primary receives a further 1,000 rad and supplementary radiation is given to palpable lymph nodes so that they receive at least a dose of 7,000 rads in a minimum of seven weeks. The necessity and indications of the use of a split field in the treatment of cervical lymph node areas are described in detail. A formula was derived from experimental data for 70 cm SSD split fields, which enables the central penumbral isodose separation to be calculated as a function of shield width and depth below skin surface. (Telecobalt source size: 1.7 cm diameter; Distance from source to nearest surface of shield: 49 cm). An account is also given of the post-radiation complications that may occur and methods for their prevention. Protective devices to shield cornea, globe and orbit are described, together with a segmented shield with a tapered cross-section which is used in conjunction with anterior split fields. (auth)

31180 RADIOLOGICAL FEATURES NOTED ON PLAIN RADIOGRAPHS IN MALNUTRITION IN AFRICAN CHILDREN. Reichman, Percy; Stein, Harry (Baragwanath Hospital, Johannesburg). Brit. J. Radiol., 41: 296-9(Apr. 1968).

Forty severe cases of primary malnutrition, uncomplicated by broncho-pneumonia or gastro-enteritis, were studied in African infants. The main radiological features found were: The lungs showed underfilling of the peripheral blood vessels. The reduced vascularity may account for the increased incidence of bronchopneumonia occurring in malnutrition. There was no recognizable cardiomegaly. Radiographs of the abdomen showed distension and fluid levels in both small and large bowel. The ossification centers and bone age were not affected. Scurvy was not seen. Rickets was rarely encountered and its incidence was lower than that in better fed children. Osteoporosis, despite protein insufficiency, was recognized in only a small percentage of the series. (auth)

31181 REACTIVITIES OF RADIATION-PROTECTIVE AMINOALKYLISOTHIURONIUM SALTS. II. SPECTROPHOTOMETRIC STUDIES ON THE REDUCTIVITIES OF 2-MERCAPTOETHYLAMINE, 2-MERCAPTOETHYL-, AND 3-MERCAPTOPROPYL-GUANIDINE. Hanaki, Akira; Hino, Tohru; Akaboshi, Sanya (National Inst. of Radiological Sciences, Chiba, Japan). Chem. Pharm. Bull. (Tokyo), 15: 1446-52(Oct. 1967).

Aminoalkylisothiuronium salts capable of being transguanylated to mercaptoalkylguanidines possess a protective action against a lethal dose of ionizing radiation. The transguanylation of 2-aminoethylisothiuronium bromide hydrobromide (AET) and 3-aminopropylisothiuronium bromide hydrobromide (APT) occurred rapidly and quantitatively. It was accompanied by the acid-dissociation of the amino group; i.e., the conjugate base of the thiuronium salt was transformed to the sulfhydryl compounds mercaptoethylguanidine (MEG) and mercaptopropylguanidine (MPG), respectively, which was determined spectrophotometrically with ferric 1,10-phenanthrolinate. The ferric complex enhanced the transguanylation of AET but not APT. This finding suggested the possibility that AET would be easily transguanylated by metal ions or metal complexes contained in body fluids, even though AET itself was injected. Aminothiols, such as mercaptoethylamine (MEA), MEG and MPG, displayed 2 maxima in reduction ability; one appeared at pH 3.2 and another at pH 5.0, with a minimum at pH 4.0. In these two pH regions, the reaction pathways and the products may be different. In the acid region the reductivities were parallel with the acidities of the amino thiols. The transguanylation is important in regard to radioprotection since the sulfhydryl compound produced in biological fluids has been proposed as the active agent of the thiuronium salt as a radioprotector. Therefore, thiuronium salts capable of being transguanylated, such as AET or APT, are radioprotectors belonging to the same category as aminothiols. The radiation-protective abilities of aminothiols was attributed to the reactivity, especially the reductivity, of sulfhydryl groups. (BBB)

31182 RADIUM THERAPY OF MALIGNANT TUMORS OF THE MAXILLA WITH THE AID OF LINEAR ACCELERATOR. Vorob'ev, Yu. I.; Holmes, K. S. (Moscow Scientific-Research Inst. of Roentgen-Radiology). Med. Radiol., 12: No. 10, 6-13 (Oct. 1967). (In Russian).

Between 1956 and 1960, 69 patients suffering from malignant neoplasms of the upper jaw were subjected to treatment. A large group comprised patients (51) with second and fourth (13 persons) stages of the disease; only in five cases the second stage of the disease was diagnosed. Irradiation was carried out on a linear accelerator with bremsstrahlung energy of 4 MeV. The total dose per focus ranged from 4,500 to 6,000 rad. The number, size and localization of the fields, as well as the choice of wedge-like filters, were dependent upon the features peculiar to the localization and spread of the neoplasm. A five-year cure in the use of radium therapy as an independent method of treatment was achieved in 22% of the patients. (auth)

31183 SALIVARY GLAND SCINTIGRAPHY WITH ^{99m}Tc-PERTECHNETATE. Boerner, W.; Gruenberg, H.; Moll, E. (Univ., Wuerzburg, Ger.). pp 453-8 of Radioisotope in der Gastroenterologie, Dritte, Jahrestag. Ges. Nuklearmed., Lausanne, Oct. 21 to 23, 1965. Stuttgart, F. K. Schattauer-Verlag, 1967. (In German).

Salivery gland scintigraphy was advantageous because the functional status of each gland was tested. Temporary functional disturbances, disturbances of secretory innervation, and disturbances of sensory mucosal innervation were evaluated. This procedure permitted evaluation of function of the small polyostotic palatinate gland, that could not be done by other methods. Salivary gland scintigraphy had less value for detection of tumors of the large salivary glands. It is a valuable supplement to palpation and sialography of the parotid gland. Results from 60 salivary gland studies are discussed. Following intravenous administration ^{99m}Tc was concentrated in the salivary glands by a factor of 60 to 200 compared to its concentration in serum. The thyroid irradiation dose from 500 μCi of ^{131}I is 800 rad compared to only 0.2 to 0.4 rad from 1 mCi of ^{99m}Tc. (BBB)

31184 SIMPLE DIFFERENTIATOR UNIT FOR DETERMINING THE MEAN CIRCULATION TIME OF A RADIOACTIVE BOLUS. Bell, T. K.; McKittrick, N.; Taylor, A. R. (Royal Victoria Hospital, Belfast). Lab. Pract., 17: 359(Mar. 1968).

Reference is made to a cuff technique for administering a bolus of ^{131}I-hippuran into the arm under increased venous pressure, to ensure reproducibility from patient to patient. A number of parameters in the range of 4 to 18 sec may be determined, including arm to head appearance time, appearance to peak activity time, and mean circulation time through the head. The latter parameter may be determined directly from the first derivative of the observed curve using simple capacitance differentiation. Considerable noise arises, however, in addition to the desired signal if the ratemeter output is fed directly into the differentiator. A description is given of a modification of Oldendorf's technique of introducing a low pass filter at the ratemeter output, before feeding the signals to a servo recorder. This modification yields a low impedance differentiated signal to operate a 5 mA chart recorder. (UK)

31185 STANDARDISATION OF METHODS FOR DOSE-NORMALISATION IN RADIOTHERAPY. Karzmark, C. J. (Univ. of Texas, Houston); Sampiere, V. A.; Stovall, Marilyn; Castro, J. R.; Peterson, Mary D. Brit. J. Radiol., 41: 317-8 (Apr. 1968).

In relating the output of a radiation source to the dose delivered to a specific site in an irradiated tissue, it is convenient to use a dose-normalization factor. The lack of agreed conventions in determination of this factor results in difficulties when a patient's therapy is being reviewed or changes to a new technique or radiation source. It is suggested that a study be conducted to determine how dose-normalization methods can be simplified and standardized. (M.M.B.)

31186 STUDIES ON RADIOSENSITIZERS IN THE TREATMENT OF MALIGNANT BRAIN TUMORS. Sano, Keiji; Hoshino, Takao; Nagai, Masakatsu; Tsuchida, Tomio; Sato, Fumiaki (Tokyo Univ.). No To Shinkei, 19: 339-44(Apr. 1967). (In Japanese).

Bromouridine (5-bromo-2′-deoxyuridine or BUdR), which was known to sensitize bacterial cells or stained tumor cells to irradiation, was incorporated into the nuclei of cultured human brain tumor cells. The uptake of BUdR into the tumor cell nuclei in tissue culture was enhanced by addition of a small amount of antimetabolites such as methotrexate, 5-FU or FUdR. The principle of the method consisted of the administration of BUdR (500 to 1000 mg/day) with a small amount of antimetabolite (e.g., methotrexate 1.5 to 5.0 mg/day) by means of continuous intraarterial (internal carotid) infusion for more than one generation time of the tumor cells (three to seven weeks in brain tumors according to their malignancy) and simultaneous radiation therapy (5000- to 6000-R tumor doses). This therapy was applied to eight brain tumor cases with good therapeutic results. (BBB)

31187 SURVIVAL OF FROZEN STORED HUMAN AND MOUSE BONE MARROW CELLS. Kurnick, N. B.; Nokay, Naime; Hampton, Beverly (Veterans Administration Hospital, Long Beach, Calif. Univ. of California, Los Angeles). Radiat. Res., 32: 706-22 (1967).

Survival of human bone marrow stored in 15% glycerol (final concentration) in Osgood's medium was investigated by determination of preservation of morphologic integrity, exclusion of Trypan Blue, and incorporation of tritiated thymidine. The results indicate effective preservation for as long as 7 years. Studies with mouse bone marrow stored for up to 1 year, using the same measurements plus the effectiveness of the marrow in protecting the mice against lethal whole-body x-irradiation, suggest that the capacity to incorporate tritiated thymidine correlates most closely with the protective ability of the bone marrow. For prolonged storage, glycerol was found to be more effective than DMSO as a preservative. (auth)

31188 STUDIES ON THE EFFECTS OF VARIOUS ANTICANCER AGENTS ON IRRADIATED MICE. **Nagata, Nobuo (Hiroshima Univ.). Hiroshima Daigaku Igaku Zasshi, 15: 391-426(May-June 1967). (In Japanese).**

The effects of various anticancer agents on mice irradiated with x rays, ^{60}Co γ rays, and 14.1-MeV fast neutrons were studied. The ddN strain male mice of about 20 g body weight were irradiated as follows: X rays; a dose of 450 R (to produce acute effects) and 50 R for 10 days (chronic effects). Various anticancer agents were administered in experimental groups at 10 to 12 days after irradiation, for 20 days; ^{60}Co γ rays; a dose of 650 R or 70 R for 15 days. The anticancer agents were administered at seven to ten days after irradiation for 24 days; 14.1-MeV neutrons; a dose of 400 rad. The anticancer agents were administered at four days after irradiation for 26 days. The agents given were, in mg/Kg, Nitromin, 5.0; Endoxan, 20.0; Thio-TEPA, 1.0; Mitomycin C, 0.2; chromomycin A$_3$, 0.1; Hg-hematoporphyrin, 2.5; and cobalt-protoporphyrin, 5.0. In the acute x-irradiation experiment, the irradiated mice showed a survival rate of 100%. The control (irradiated-only) group decreased in body weight initially, then increased progressively. The experimental mice showed variations in the body weights, increases depending on the drug. The white blood cells decreased 87% at three days then gradually recovered. In experimental group the reversal of the white cell decrease was inhibited. Damage to liver and spleen tissue had disappeared almost completely in the control group at 30 days after irradiation, but some disturbances were still observed in the experimental groups at 40 days. In the ^{60}Co γ irradiation group a higher mortality was observed. The body weight decrease was eliminated rapidly in the control group while most experimental groups showed an inhibition in body weight recovery. Histological observations of tissues were similar to those for the x irradiation series. (BBB)

31189 STUDIES ON THE RELATIONSHIP BETWEEN DOSAGE AND THE LOCAL RESULTS OF IRRADIATION IN HODGKIN'S DISEASES. **Glinska, Halina; Skolyszewski, Jan (Inst. of Oncology, Krakow). Nowotwory, 17: 225-31(July-Sept. 1967). (In Polish).**

Optimal local doses for granuloma, lymphosarcoma and other, histologically undetermined neoplasms (3500 R) and for reticulosarcoma (4500 R) applied for three weeks were established on the basis of a correlation between the dose and the local result of irradiation of patients with Hodgkin's disease. A high percentage of positive local results was obtained for irradiation of lesions localized in peripheral lymph nodes and in the pharyngeal lymphoid ring. Results obtained for deep lymph nodes and for neoplasms located elsewhere were not as good. A correlation was observed between the size of the peripheral lymph nodes and the local result of treatment. (auth)

31190 SURGICAL REMOVAL OF ALTERED APPENDICES IN PATIENTS WITH CARCINOMA OF THE CERVIX UTERI BEFORE IRRADIATION. **Medvey, Wojciech; Janowska, Ewa (Inst. of Oncology, Krakow). Nowotwory, 17: 271-5(July-Sept. 1967). (In Polish).**

Complications resulting from peritonitis in the group of 1908 patients with carcinoma of the cervix uteri irradiated in the Oncological Institute in Cracow were analysed. Peritonitis was observed in 62 patients (3.2 percent) during treatment, causing death of 12 patients (0.6 percent). It was found that patients with peritonitis complications were relatively young, had previously more frequently appendicitis and higher leukocytosis. The inflammatory lesions were also more frequently observed than in patients without peritonitis complications. Probability of occurrence of peritonitis was particularly high in patients in which clinical lesions of appendices (15.8 percent) were detected. Less frequently (1.8 percent) observed was peritonitis in patients without clinical changes in appendices. This complication was not observed, however, in 19 patients with appendices removed before irradiation. Surgical removal of clinically altered appendices directly before irradiation decreases the risk of peritonitis. (auth)

31191 THE EFFECT OF BREATHING OXYGEN AT HIGH PRESSURE ON THE OXYGENATION OF A SARCOMA IN CBA MICE. **Baker, D. J. (Medical Coll. of St. Bartholomew's Hospital, London); Lindop, Patricia J.; Hewitt, H. B. Brit. J. Radiol., 41: 318-9(Apr. 1968).**

From the point of view of radiotherapy it is important to know whether hypoxic cells are present in a tumor, whether oxygen reaches these cells when it is administered under hyperbaric conditions, and whether there is a relation between oxygen cathode readings in a tissue and the response of that tissue to radiation. Experiments using mice are described which showed that the tumors examined contained hypoxic regions and that in all but two measurements the oxygen availability to these regions was increased by high pressure. (M.M.B.)

31192 THE RADIOTHERAPY OF THE BRAIN TUMORS. **Takeuchi, Kazuo; Mizutani, Hiroshi; Yahagi, Yasuharu; Ogashiwa, Motohide; Oda, Masaharu (Toranomon Hospital, Japan). No To Shinkei, 19: 347-52(Apr. 1967). (In Japanese).**

Of 96 verified cases of intracranial gliomas, 74 cases were irradiated by more than 2000 R (^{60}Co). Average survival improved twofold in the irradiated cases. The efficacy of γ irradiation therapy was greater for the increased intracranial pressure than for the neurological symptoms, but radiotherapy fell off in its efficacy with repetition. In 11 cases of metastatic brain tumors in which intracranial foci may have been fatal, the average survivals since the first manifestation of the neurological symptoms were improved about twice with postoperative radiotherapy. The average duration of suppression of intracranial pressure in irradiated patients was six times as much as in untreated cases. The same was true of 19 patients with craniopharyngiomas, with average survival of 57 months in the cases with radiation and 27 months without it. The sensitivity of a brain tumor to ionizing irradiation varies in efficacy with type of case and time of treatment, and so a method of tissue culture sensitivity test was devised. The criterion of tumor radiosensitivity was taken as half the rate of degeneration of cultured cells in a five day culture following irradiation with 4000 R. In 14 cultures some were positively correlated to clinical findings. (BBB)

31193 THE RANGE OF RADIOPROTECTIVE DOSES OF MEXAMINE. **Strelkov, R. B. (Experimental Pathology and Therapy Inst., Sukhumi, USSR). Farmakol. Toksikol., 31: 98-100(Jan.-Feb. 1968). (In Russian).**

Mexamine (5-methoxytryptamine) was found to have a broad spectrum of radioprotective action in mice. Mice weighing 18 to 20 g were irradiated with 900-R doses by a ^{60}Co γ ray source at 60 to 65 R/min. Their 30-day survival time and tissue oxygen content were determined after 0, 1, 5, 10, 30, 75, and 350 mg/Kg doses of the drug were given before irradiation. Its effectiveness began with a dose of 5 mg/Kg; and the maximal protective action was observed with a dose of 7.5 mg/Kg. Essentially, the effectiveness (up to 40% 30-day survivors vs 0.9% in controls) did not change with dose level up to 100 mg/Kg. Moreover, greater increase of the mexamine dose induced the sudden appearance of toxic symptoms and a large percentage of animals died prior to development of radiation sickness (15% 30-day survivors at 350 mg/Kg). Mexamine in 1-mg/Kg doses failed to produce hypoxia in tissues. A 5-mg/Kg dose caused a slight decrease in the oxygen tension in tissues; and doses of 10, 30, 75, and 350 mg/Kg reduced the oxygen content in tissues by 30%. The oxygen decrease in tissues attained with the 10-mg/Kg dose of mexamine given to animals was not further enhanced after administration of a considerably larger dose of the compound. It appeared that a mexamine dose of 7.5 to 10 mg/Kg is sufficient to provide resistance to lethal irradiation and, in particular, helps to maintain the oxygen balance in radiosensitive organs and tissues. When the mexamine dose is increased to a level causing the appearance of toxicity symptoms, it may intensify the severity of the radiation injury. (BBB)

31194 THE SIGNIFICANCE OF ^{99m}Tc FOR NUCLEAR MEDICAL LOCALIZATION DIAGNOSIS. **Boerner, W.; Moll, E.; Bayer, H. (Univ., Wuerzburg, Ger.). pp 305-14 of Radioisotope in der Gastroenterologie, Dritte Jahrestag. Ges. Nuklaearmed., Lausanne, Oct. 21 to 23, 1965. Stuttgart, F. K. Schattauer-Verlag, 1967. (In German).**

Uses of ^{99m}Tc in scintigraphy of the thyroid gland, salivary glands, and brain were reviewed. After administration of ^{131}I, ^{125}I, ^{99m}Tc, and a combination of ^{99m}Tc and ^{132}I, in amounts of 25, 25, 250, 250, and 10 μCi, respectively the calculated whole-body irradiation burdens were 25, 15, 3.5, and, for the combined treatment, 5.5 mR. The corresponding irradiations of the thyroid amounted to 40,000, 20,000, 50, and 200 mrad, respectively. The irradiation burden to the thyroid gland from ^{99m}Tc is $^{1}/_{200}$ of that from ^{131}I, and the scintigraphic resolution was better than with ^{131}I and ^{125}I. The whole-body irradiation burdens from 500 μCi of

^{203}Hg or 700 μCi of ^{197}Hg, 400 μCi of ^{131}I serum albumin, or 5000 μCi of ^{99m}Tc were 80, 1000, and 60 mrad, respectively. The dose to the kidneys from ^{203}Hg was about 40,000 mrad, and from ^{197}Hg it was ~3700 mrad. From orally administered ^{99m}Tc the dose to the upper small intestine was 1200 mrad, and when given intravenously it was 500 mrad. (BBB)

31195 THERAPY OF RADIATION INJURIES OF THE SKIN. **Ziegenbalg, Hans (Poliklinik fuer Hautkrankheiten der Medizinischen Akademie Carl Gustav Carus, Dresden). Aesthet. Med., 14: 74-84(Mar. 20, 1965). (In German).**

Plastic surgical repair of areas from which spinaliomas, irradiation ulcers, and melanomas were removed is described and illustrated. The procedures were undertaken where previous irradiation had either failed to destroy the tumor, or where in many cases the injury was induced or worsened by previous irradiation treatment. The irradiation treatment doses that the patients received prior to plastic surgery ranged as high as 7000 R. The author briefly discussed the background of each case, and described and illustrated the methods of repair of the skin defects. (BBB)

31196 TREATMENT OF HYPERTHYROIDISM WITH ^{131}I: ONE TO TEN YEARS' FOLLOW-UP ON 285 CASES. **Shizume, Kazuo; Irie, Minoru; Ishii, Jun; Matsuda, Kunio; Nagataki, Shigenobu; Matsuzaki, Fukashi; Sakuma, Maki; Suematsu, Hiroyuki; Nakao, Kiku (Tokyo Univ.). Endocrinol. Jap., 14: 225-7(Sept. 1967).**

Hazards of radioiodine therapy of hyperthyroidism were analyzed in a large patient series, with emphasis on the reduction of the most frequent and serious complication, hypothyroidism. From 1955 to 1964, 415 cases of hyperthyroidism were treated and results were traced in 285. The ^{131}I dose was calculated to retain 80 to 100 μCi of ^{131}I per g of thyroid tissue at 24 hr. If the patient showed no improvement after three to five months, or if improvement was not adequate after six to nine months, a second dose of ^{131}I calculated in the same manner was administered. Readministration of ^{131}I was repeated in this way until the patient became euthyroid. Of the 285 cases, 85.6% were euthyroid, 8.4% hypothyroid, and 6.0% still hyperthyroid. The incidence of hypothyroidism increased relative to time after treatment. The relatively low incidence of hypothyroidism in this series, compared with the reports from Western countries, was probably due to the relatively low dose of ^{131}I used in each treatment. The high content of iodine in the Japanese diet might have some relation to this low incidence. No incidence of thyroid tumor or leukemia was observed in these patients, and no abnormalities were observed in 41 children born from 27 patients after ^{131}I treatment. (BBB)

31197 TOOTH DAMAGE FOLLOWING RADIATION THERAPY OF MALIGNANT TUMORS IN THE MAXILLOFACIAL REGION. **Barer, G. M.; Nazarov, G. I. (Medical Stomatology Inst., Moscow). Stomatologiya, 44: 23-6(1965). (In Russian).**

Studies are reported on 25 patients (17 males, eight females), aged 45 to 65 yr, who developed ulceration of bone, that is, radioosteonecrosis, to various degrees and in various regions. Clinical examinations revealed that 300 teeth were damaged to various degrees six months to four yr following the completion of telegamma therapy, combined with x ray and interstitial γ ray therapy (total dose 3700 to 4000 rad). The treatments were intended to eradicate malignant neoplasms near the membranous bones to each side of the lower part of the face and on the upper jaw, also on the anterior part of the hard palate, on the soft palate, and on the tongue. It was estimated that molar teeth of the upper and lower jaws absorbed about 2000 to 3000 rad and the front teeth about 1800 to 2000 rad. This caused severe damage to the dental hard tissues according to the magnitude of the absorbed dose of radiation. Damage to hard tissues of teeth was accompanied by changes in response to electrostimulation of the pulp and the soft, highly vascular and sensitive tissue filling the central cavity of teeth, whereupon the pulp was gradually destroyed and the extraction of teeth became unavoidable. Radiographs of the injured teeth are illustrated. (BBB)

31198 STUDIES ON DIAGNOSTIC APPLICATION OF RADIOISOTOPES IN NEUROSURGERY. I. LOCALIZATION OF INTRACRANIAL NEOPLASMS WITH RADIOISOTOPES. **Kodama, Motomu (Hirshima Univ.). Hiroshima Daigaku Igaku Zasshi, 15: 469-93(May-June 1967). (In Japanese).**

The application of various radioisotopes to diagnosis in neurosurgery is reviewed. The types and doses of radioisotopes considered that were used in the diagnosis of intracranial neoplasms included ^{131}I-RISA (radioiodinated human serum albumin), ^{131}I-PVP (polyvinylpyrrolidone), ^{131}I-antifibrinogen, 300 μCi intravenously (IV), ^{121}I-MAA (macroaggregated albumin) 100 μCi; ^{203}Hg-or ^{197}Hg-Chlormerodrin 700 μCi, (IV), ^{32}P as disodium phosphate, 0.5 to 1.0 mCi IV, ^{99m}Tc-pertechnetate as Tc–Fe complex, 5 to 15 mCi (IV), ^{64}Cu-copper acetate or Versenate, 30 to 60 μCi/Kg IV, ^{72}As or ^{74}As as ammonium arsenate, 1.5 mCi IV, ^{206}Bi nitrate or -chloride 300 μCi IV, ^{42}K as potassium chloride 10 mCi/kg inj., ^{68}Ga as a chelate compound, 250 μCi, ^{18}F as fluoborate, 1 to 3 mCi IV. Before using ^{131}I, the patient was given Lugol's solution, nine drops/day for three days to inhibit ^{131}I uptake by the thyroid, while mercury diuretics were injected 12 to 24 hr before use of ^{197}Hg or ^{203}Hg to inhibit the accumulation of radiomercury in kidney. In the diagnosis of intracranial neoplasms, ^{131}I-PVP or Na^{131}I, 300 to 500 mCi was injected intravenously 12 to 24 hr after ^{131}I-PVP injection or 2 to 12 hr after Na^{131}I injection and the radioactivity was measured. The scintillation counter aimed at certain sites on the head and the radioactivity scanned. Systematic counting at 32 locations was conducted. The diagnosis of intracranial neoplasms by radioisotope brain scanning, was compared with other methods. Among a group of brain tumor cases, positive diagnosis of disease was 77% by radioisotope scanning, 69% by angiography, 53% by electroencephalographic examination, and 41% by ultrasonic diagnosis. (BBB)

31199 THE RADIOTHERAPY–CHEMOTHERAPY ASSOCIATION IN HODGKIN'S DISEASE. **Gary-Bobo, J. (Centre Regional de Lutte contre le Cancer, Montpellier, France). J. Radiol., Electrol., Med. Nucl., 48: 225-8(Mar.-Apr. 1967). (In French).**

The results of a study on the curative effects of Vincaleukoblastine combined with x radiation in the treatment of Hodgkin's disease are reported. The results showed that the combination of these two agents caused complete remission in some cases and partial remission in others. (J.S.R.)

31200 THE CLOSURE OF EXTENSIVE CHEEK DEFECTS BY LOCAL FLAPS. **Krueger, E. (Univ., Hamburg). Deut. Zahn- Mund- Kieferheilk., 47: 333-9(1966). (In German).**

Following treatment with 6000 R of x irradiation for recurrence of a squamous cell carcinoma of the lower mandible, necrosis of the cheek mucosa developed. The tumor was not affected, and the patient required extensive facial plastic surgery. Similar surgical procedures are described by the author for repair of other irradiated carcinomas of the facial area, and for injuries of the skin and subcutaneous tissue after x irradiation of a hemangioma. (BBB)

31201 TRANSFUSION THERAPY OF ACUTE RADIATION SICKNESS COMPLICATED BY THE LOSS OF BLOOD. **Bepsebaev, A. A. Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol., 1: 372-4 (1965). (In Russian).**

Three groups of rabbits (106) received 600 R of total-body radiation with 190-KV x rays at 21 R/min, and then were bled (16.5 ml/Kg) from the femoral artery. Controls developed acute radiation sickness simultaneously with the other groups but were not subjected to blood withdrawal. All three groups received a transfusion of blood from donor rabbits to which 1 ml of 5% citrate solution was added per 10 ml of blood. Thus, the first group (39 rabbits) received whole and freshly citrated blood two hr after irradiation, the second group (36 rabbits) on the third postirradiation day, and the third group (31 rabbits) on the ninth postirradiation day. Condition of the survival animals was then followed by clinical observations, and their behavior, attitude toward food, hemorrhage in the oral cavity, bloody diarrhea, and variations in weight were also noted. Blood composition, numbers of erythrocytes, reticulocytes, and leucocytes and hemoglobin levels were examined prior to and after irradiation, as well as after blood withdrawal and blood transfusion, then every third day up to 15th day of the experiment and every fifth and tenth day thereafter for three months following irradiation. The transfusions given at various periods of radiation sickness resulted in therapeutic effects which depended on a fixed time elapsed after irradiation. The most effective blood transfusion was that given two hr after irradiation (of ten rabbits nine survived, but only seven in controls) and that given during the latent period on the third day after irradiation (of ten rabbits seven survived, only four in controls). A milder course of radiation sickness resulted, without severe anemia or leucopenia. Blood transfusions given during the peak of the radiation sickness (on the ninth day after irradiation) had no beneficial effect on the course of the radiation sickness (of ten rabbits four survived, two in controls) and, in sporadic cases, even intensified the severity of the hemorrhagic syndrome. However, comparison with control groups showed a much earlier normalization of red blood cell levels and some decrease in mortality rate. (BBB)

Radiation Effects on Animals

Refer also to abstracts 30784, 30944, 30951, 30957, 30958, 30963, 30965, 30968, 30981, 30987, 30995, 31001–31003, 31009, 31011, 31018, 31019, 31021, 31026, 31029, 31030, 31032–31036, 31045, *31049, 31050, 31054, 31069, 31078, 31089, 31100, 31101, 31109, 31122, 31127, 31128, 31130, 31132, 31133, 31135–31137, 31141, 31146–31152, 31154, 31157, 31160, 31161, 31163–31166, 31170, 31173, 31174, 31176, 31178, 31179, 31185, 31187–31190, 31192, 31193, 31195–31197, 31200, and 31201.*

31202 (AD–666139) RADIATION INJURY OF MYELOPOIESIS IN MONKEYS. Novikova, M. I. Translated from Med. Radiol., 10: No. 6, 42-6(1965). 10p. (FTD-MT-24-154-67). CFSTI.

Gamma radiation (540 to 630 R) completely suppressed hemopoiesis in monkeys. During the first eight days after exposure, leukocyte count in the peripheral blood dropped sharply, but the red blood cells showed no significant abnormalities. From the 9th to the 19th day, suppression of hemopoiesis became more pronounced. The leukocyte count dropped further and the concentration of hemoglobin decreased in the red blood cells. Thirty percent of the animals died during this period but the first signs of recovery began to appear—occasional immature cell forms in the red marrow, and reticulocytes in the peripheral blood. During the third or restorative period (20th to 60th day) the animals appeared completely healthy, and the peripheral blood indices were more or less normal. It is suggested that these experiments may help to uncover the mechanisms underlying the development of leukemia and aplastic anemia caused by ionizing radiation. (auth)

31203 (BNWL-SA-1753) HIT THEORY AND MICRODOSIMETRY. Roesch, W. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 1, 1968. Contract AT(45-1)-1830. 13p. (CONF-680421-2). Dep. CFSTI.

From 16th Annual Radiation Research Society Meeting, Houston, Tex.

Hit theory and microdosimetry are discussed, and an illustration of their use in the study of the RBE problem is presented in an effort to describe radiation effects on biological systems. (W.H.K.)

31204 (BNL–50088) EXTRACORPOREAL IRRADIATION OF THE BLOOD AND LYMPH IN THE STUDY OF NORMAL AND LEUKEMIC CELL PROLIFERATION. Brookhaven Lecture Series Number 48. Cronkite, Eugene P. (Brookhaven National Lab., Upton, N. Y.). June 23, 1965, Revised Dec. 1967. 23p. Dep. CFSTI.

Background material on extracorporeal irradiation of the blood and lymph (ECIB or ECIL) in the study of normal and leukemic cell proliferation is presented in the form of brief discussions on general morphological characteristics of lymphocytes; lymphocyte life span, size, migration pathways, and function; development of ECIB and ECIL; prevention of blood clotting during ECIB; general considerations of radiation dose to the blood; induction and recovery from lymphopenia; depletion of lymphoreticular tissues; effects of ECIB and ECIL on skin allografts; leukemia; effects of ECIB upon leukemia in cattle and man, chronic granulocytic leukemia, chronic lymphocytic leukemia, and acute myeloblastic leukemia. (B.S.L.)

31205 (TID–23280) THE EFFECTS OF GAMMA RADIATION ON EARTHWORMS, ALGAE, AND ROTIFERS. Eno, Charles F. (Florida Univ., Gainesville. Dept. of Soils). [nd]. 11p. Dep. CFSTI.

Two species of earthworms, Lumbricus terrestris and Eudrilus eugenia, were given varying doses of gamma radiation. The number of survivors was reduced below that of controls for all levels of irradiation. Little difference in survival of Eudrilus eugenia occurred during the first six weeks at 0, 8, 16, and 32 kR, whereas Lumbricus terrestris showed significant differences among these levels as early as two weeks subsequent to irradiation. Algae (Chlorococcum and Chlorella) irradiated through levels of 100 kR increased in quantity throughout the 32 day period. All levels above 500 kR resulted in essentially complete sterilization. Chlorella appeared to grow at somewhat higher doses than Chlorococcum. In contrast to other lower forms of life, rotifers (Bdelloides sp.) were affected rather severely at low dose rates. No rotifers survived above 300 kR on the 26th day, above 600 kR on the sixth day, and above 1000 kR on the first day. (H.L.W.)

31206 (UR–49-943) ERYTHROCYTE AGE: DENSITY: VOLUME RELATIONSHIPS IN NORMOBLASTIC AND NON-NORMOBLASTIC ERYTHROPOIESIS. Coopersmith, Alan (Rochester Univ., N. Y. School of Medicine and Dentistry). 1967. Contract W-7401-eng-49. 301p. Dep. CFSTI.

Thesis.

Experiments were designed to determine the age : density : volume relations of dog erythrocytes produced under four different erythropoietic conditions: normoblastic erythropoiesis, non-normoblastic erythropoiesis (following acute blood loss), erythropoiesis following acute temporary blood loss, and erythropoiesis following acute blood loss in old and old-irradiated dogs. A blood fractionation tube especially designed for these experiments is described. The results of the experiments are interpreted in light of classical and proposed concepts of red cell production. The density of normal dog erythrocytes increases as the cells age, although there is no significant alteration in the cell volume during ageing. The volume distribution of normal erythrocytes of all ages is bimodal (in both a synthetic medium and autologous serum), indicating two populations of red cells in peripheral blood. The bimodality of the volume histograms is related to antecedent mitotic history of individual erythrocytes. It is suggested that normoblastic erythropoiesis is a proliferating cell system in which the majority of erythrocytes mature from orthochromatic normoblasts produced following five cell divisions; concommitantly, other erythrocytes are produced from orthochromatic normoblasts produced following four mitotic divisions. Cells produced by each of the two maturation sequences comprise the two populations seen in the normal histogram. Alterations in the relative size of the two populations serve as a sensitive indicator of altered erythropoiesis. Erythrocytes produced in response to acute blood loss (macrocytes) are characterized by increased cell volume, decreased life-span (life-span of 21 days as compared to the accepted value of 100 days for normocytes), and saltatory increases in cellular density during in vivo ageing. The mean cell volume (MCV) of macrocytes is approximately twice normal. The production and influx of macrocytes into the peripheral blood alters the volume histogram. The second cell population increases in size; all newly produced cells are as large as normal second population erythrocytes, and some cells with volumes even larger than normal second population erythrocytes are produced. Shifts to the right (toward larger volume) in the volume histogram are attributed to skipped mitotic divisions of precursor cells. The response of animals to periods of anemia induced by temporary acute blood loss for five or three hours is characterized by moderate increases in the percent reticulocytes in the whole blood and by small but significant increases in the MCV of newly released erythrocytes. In contrast to the response to acute blood loss (i.e., alteration in the kinetics of cellular proliferation), it is suggested that short-term anemia causes alteration in the pattern of cell release of already-formed erythrocytes, rather than alteration in the mode of cell production. The response of old and old-irradiated dogs to acute blood loss is characterized by an exaggerated and accelerated macrocytosis. In addition, the rate of recovery from blood loss is slower in these animals than it is in younger, non-irradiated dogs. The differences between the responses of old-irradiated dogs and younger normal dogs to acute blood loss are interpreted as reflecting effects of ageing and of residual radiation damage of the stem cell pool. A mathematical model of normocyte and macrocyte production is presented and discussed. (auth)

31207 (UCRL–17751) JOINT NASA–AEC PROGRAM IN SPACE RADIATION BIOLOGY. Progress Report, Fall 1967. (California Univ., Berkeley. Lawrence Radiation Lab.). Sept. 1967. Contracts W-7405-eng-48; R-104. 143p. Dep. CFSTI.

Separate abstracts were prepared for five sections of this report. (H.L.W.)

For abstracts of individual sections see: 30868, 30937, 30938, 31208, and 31209.

31208 (UCRL–17751, pp 41-51) RADIATION EFFECTS IN SPACE FLIGHT. (California Univ., Berkeley. Lawrence Radiation Lab.).

INSECTA—Tribolium confusum, radiation effects on development of, effects of centrifugation, dose, and vibrations on x

31209 (UCRL–17751, pp 81-141) MAMMALIAN RADIOBIOLOGY. (California Univ., Berkeley. Lawrence Radiation Lab.).

DOGS—radiation effects on iron-59 content of blood plasma and erythrocytes of, effects of altitude and hypoxia on proton
EARS—vestibular organs of, function and structure of, as related to space research; radiation effects on function and structure of vestibular organs in, of monkeys and rabbits, γ
AMPHIBIA—Rana pipiens, radiation effects on righting reflex of, proton
CATS—radiation effects on vestibular apparatus of, alpha
ALPHA PARTICLES—effects on brain of cats and monkeys
SPACE—radiation hazards of, mathematical models for

31210 BLOOD COAGULATING SYSTEM AND VASCULAR RESISTANCE IN PATIENTS WITH UTERINE CANCER DURING RADIATION THERAPY. Baronina, L. A.; Tsilyurik, I. T. (Tornopol Medical Inst., USSR). Med. Radiol., 12: No. 10, 21-4(Oct. 1967). (In Russian).

Recalcification time, amounts of proaccelerin, proconvertin and prothrombin, prothrombin consumption, blood clot retraction index, free blood heparin, thrombin time, and skin capillaries resistance were determined in 130 patients undergoing radiation therapy. The investigations demonstrated an appreciably reduced recalcification time, a drop in the amount of proaccelerin and proconvertin and diminished blood clot retraction index. The blood coagulating system changed only under the effect of irradiation in high doses. Beam therapy led to a decrease of vascular resistance in the patients. With an increase of the irradiation dose more pronounced changes in the blood coagulating system and vascular resistance were noted. (auth)

31211 CELL PROLIFERATION IN THE REGENERATING LIVER AND THE EFFECT OF PRIOR CONTINUOUS IRRADIATION. Fabrikant, Jacob I. (Inst. of Cancer Research, Surrey, Eng.). Radiat. Res., 32: 804-26(1967).

The effect of prior continuous γ irradiation was studied at 47 rads/day for 15 days and 30 days on the patterns of proliferation of parenchymal and littoral cells in the rat liver after partial hepatectomy, and at 47 rads/day for 15 days on the S and G_2 + M/2 phases of proliferating parenchymal cells during regeneration, and for periods up to 120 days on the production of observable chromosome injury in proliferating hepatocytes. Following continuous exposure and the accumulation of large doses, cell proliferation could be initiated and maintained, albeit at a reduced rate, despite large numbers of radiation-induced chromosome aberrations. Changes in the patterns of DNA synthesis and cell division following irradiation induced altered timing with a delay in the onset of synthesis and mitosis, a decrease in the rate of entry of cells into synthesis and division, a decrease in the numbers of cells taking part in the regenerative process, and an increase in the overall period of cell proliferation. There was a slight shortening of the duration of S phase, and possibly a greater variation in the duration of the G_2 + M/2 complex phase, probably accompanied by cells held up in passage through this period. The number of radiation-induced chromosome aberrations was dependent on the duration of exposure and accumulated dose. Reduction of chromosome aberrations was not apparent after a 10-day radiation-free interval prior to partial hepatectomy. Despite the accumulation of the radiation damage, viable cells in the regenerating liver remnant divided a few times to replace a very large proportion of the parenchymal and littoral cell population deficits within the short period of one week. (auth)

31212 CHARACTERISTICS OF SPONTANEOUS NEOPLASTIC DISEASES IN HYBRID MICE. Rudali, G.; Mogul, M. R. (Inst. du Radium, Paris). Eur. J. Cancer, 3: 217-25(Aug. 1967). (In French).

Fifty-five per cent of SFL/F mice developed spontaneous lymphomas after an approximate latent period of 10 months. These were lesions of the reticulum cell and hystocytic type, and were not transmissible by cellular grafts. Cell-free extracts, prepared from advanced lesions, did not produce the phenomenon of acceleration in SFL/F mice that had received them at birth. The same extracts did not produce any reticulo-histocytic disease in C57BL or AkR mice. Electron microscopic examinations did not reveal the presence of viruses in the non-malignant tissues or in advanced lesions. X irradiation of these mice, from birth, did not increase the frequency nor shorten the latency of the lymphomas, but it induced graft transmissible lymphoid leukemias. Similar irradiations, given at age 30 days, did not seem to modify the normal frequency and latency. (auth) (TSS)

31213 CHRONIC PROGRESSIVE RADIATION MYELOPATHY. ITS CLINICAL ASPECTS AND DIFFERENTIAL DIAGNOSIS. Reagan, Thomas J.; Thomas, Juergen E.; Colby, Malcolm Y. Jr. (Mayo Clinic, Rochester, Minn.). J. Amer. Med. Ass., 203: 106-10(Jan. 8, 1968).

Ten patients with chronic progressive radiation myelopathy were studied. Most of them had primary carcinomas of head or neck and all had received radiation therapy. The interval between termination of γ or x radiation and onset of neurologic symptoms varied from 5.5 to 30 months. The lower extremities were usually affected first. Sensory symptoms predominated. The spinal cord disease was cervical in eight and dorsal in two, corresponding to the segment of the cord irradiated. In four patients, the striking neurologic finding was a Brown-Séquard syndrome, whereas in six the picture was that of an incomplete transverse myelopathy. Myelograms were normal in all but one patient. Seven patients had died; average survival time was ten months. The differential diagnosis mainly concerned intramedullary tumor metastasis and remote carcinomatous myelopathy. (auth)

31214 CHANGES OF LONG BONES IN CHILDREN AFTER ROENTGEN THERAPY. Shurygin, V. P. (Leningrad Pediatric Medical Inst.). Med. Radiol., 12: No. 10, 37-42(Oct. 1967). (In Russian).

Data are presented regarding 12 children subjected to radiation therapy for different neoplasms, in which the long bones occurred in the region of x-irradiation. There was established a direct relation between radiation injuries and the value and nature of focal doses in different regions of the bones. The meta-epiphyseal zone of growth proved to be the most sensitive in this type of irradiation. The sensitivity to x-irradiation proved to be particularly high in early childhood; there was noted a significant reorganization of the bone structure in the zone of irradiation. The author points to the possibility of pathological fractures and pseudoarthrosis as the result of osteonecrotic alterations and disturbances in the zone of irradiation of processes of regeneration. (auth)

31215 CHANGES OF THE CARDIOVASCULAR SYSTEM IN ERYTHEMA PATIENTS TREATED WITH ^{32}P. Gurevich, I. B.; Nikolaeva, N. V.; Shvedskii, B. P.; Skachilova, N. N. (Inst. of Hematology and Blood Transfusion, Moscow). Med. Radiol., 12: No. 10, 28-32(Oct. 1967). (In Russian).

A clinico-roentgenological investigation of 28 patients treated with ^{32}P and 22 patients nontreated showed that radiophosphorus exerts a diverse influence on the cardiovascular system depending on the stage of development of these changes. In the first stage in preserved normal contractile function of the myocardium in the treated patients there is a rarer occurrence of hypertrophy and dilatation of ventricles, the arterial pressure also rises more rarely in comparison with the nontreated patients. In the second stage during weakening of the myocardial contractile function the ^{32}P effect is manifested only by a lesser incidence of hypertrophy of the left ventricle and lesser rise of the arterial pressure. ECG changes are more pronounced in the treated patients. In the third stage in a marked impairment of the myocardial contractile function radiophosphorus retains its favorable effect in respect to inhibition of the progress of hypertrophy and of ventricular dilatation, and does not impede the progress of hypertension and ECG changes. (auth)

31216 CLINICAL PICTURE OF ACUTE RADIATION SICKNESS INDUCED BY RADIOACTIVE THULIUM. Kirillov, S. A.; Nesterova, V. I.; Ivanov, V. A.; Shulyatikova, A. Ya.; Drutman, R. D.; Protasova, A. K. Med. Radiol., 12: No. 10, 63-70(Oct. 1967). (In Russian).

Description of a case of acute radiation sickness of moderate severity occurring as the result of aerogenic passage into the body of radioactive thulium (^{170}Tm) is presented. The investigations disclosed that there was a dose of 500 μc of ^{170}Tm in the patient's body, the main quantity being in the lungs. The clinical picture of the disease was manifested by symptoms of affection of the liver, hematopoiesis and nervous system. Pentacene treatment resulted in a significant rise of the level of isotope excretion with the urine. (auth)

31217 DARK REACTIVATION OF DAMAGE INDUCED BY ULTRAVIOLET LIGHT IN MAMMALIAN CELLS IN VITRO. Horikawa, M.; Nikaido, O.; Sugahara, T. (Kyoto Univ.). Nature (London), 218: 489-91(May 4, 1968).

A study is described with a view to determining the difference in sensitivity of cultured mammalian cell lines to x-rays and U/V light and finding out whether the reactivation processes are identical; also to ascertain whether mechanisms could be demonstrated which split or excise U/V induced thymine dimers, representing the radiation damage. Mouse Ehrlich ascites tumour cells, mouse fibroblastic L cells, and porcine kidney stable cells, maintained in vitro, were employed in the study. The x-ray dose rate was 64R/min., and the U/V dose rate (260 mμ wavelength) 20 ergs/mm^2/sec. Methods of analysis for thymine dimers are described. No striking difference in sensitivity to x-irradiation was found for the three cell lines, but there were differences for U/V irradiation. Thymine dimers were induced by U/V irradiation at almost the same rate in the three cell lines, as a linear function of dose. Results indicated that thymine dimers induced by U/V irradiation were excised from DNA molecules in the irradiated Ehrlich cell chromosomes, and then appeared in a trichloracetic acid soluble fraction 24 hours after irradiation. It seems, however, that only some of the many established mammalian cell lines have the ability to remove thymine dimers preferentially from DNA. It was also found that caffeine can block the dark reactivation process in Ehrlich ascites tumour cells irradiated with U/V light, but does not reduce the ability of cells irradiated with ionizing radiation to form colonies. (UK)

31218 DISRUPTION OF THE CIRCADIAN RHYTHM OF TWO SPECIES OF MILLIPEDES BY LOW-LEVEL GAMMA RADIATION.

Brandon, Stacia (Louisiana State Univ., Baton Rouge). Proc. La. Acad. Sci., 30: 70-3(Dec. 31, 1967).

The nocturnalism of *Oxidus gracilis* (Koch) and *Pachydesmus c. crassicutus* (Wood) was established as circadian when tested under constant dim light, 21 ± 1C, and 74 ± 2% relative humidity. After exposure to ^{60}Co radiation at six levels ranging from 1.3 rads to 38,000 rads, activity was tested under the same conditions. *O. gracilis* irradiated with 1.3 rads showed a diminished rhythm, and the circadian rhythm had disappeared in both species by the 1980-rad level. Finally, radiation of *O. gracilis* at each of the six levels was followed by three days of exposure to a controlled photoperiod approximating the current conditions for July. This resulted in a resumption of nocturnalism in all levels at which it had been destroyed. (auth)

31219 DISTRIBUTION OF EXOGENOUS PEROXIDASE IN IRRADIATED MOUSE INTESTINE. Hampton, J. C.; Rosario, B. (Northwestern Univ., Chicago). Contract AT(11-1)-1244. Radiat. Res., 34: 209-27(1968).

Within 10 minutes after intravenous injection, horseradish peroxidase was found in the lamina propria and in the intestinal epithelium, both in intercellular spaces and within the cytoplasm of epithelial cells. Examination of intestines of mice subjected to 3 krads of x radiation and sacrificed at 24-hour intervals up to four days revealed that most intact capillaries remained patent and were permeable to peroxidase. It was not possible to characterize damage to endothelial cells on a morphological basis alone, but definite changes in permeability to peroxidase were demonstrated. Neither capillary nor epithelial basement membranes seemed to constitute a significant barrier to the extravascular diffusion of peroxidase, but at the time of villus denudation, on day four, epithelial basement membranes were disrupted in the denuded areas. Diffuse staining of epithelial cell cytoplasm by peroxidase reaction product and less accumulation of it in intercellular spaces within the epithelium was observed on days three and four postirradiation. Neither evidence of leakage through, nor secretion by, epithelial cells of peroxidase into the gut lumen nor localization within lacteals was detected. Some of the enzyme probably was secreted or diffused into the lumen before denudation occurred but escaped detection by being washed away by the tissue fixative. (auth)

31220 EFFECT OF NEGATIVE PIONS ON THE PROLIFERATIVE CAPACITY OF ASCITES TUMOR CELLS (LYMPHOMA) IN VIVO. Feola, J. M.; Richman, C.; Raju, M. R.; Curtis, S. B.; Lawrence, J. H. (Lawrence Radiation Lab., Berkeley, Calif.). Radiat. Res., 34: 70-8(1968).

The relative biological effectiveness (RBE) of negative pions in the Bragg peak region as compared to the plateau region and to gamma rays was determined. LAF_1 mice, bearing 5-day-old lymphoma ascites tumors, were irradiated in the peak and plateau regions of a 90-MeV pion beam for 40 hours in temperature-controlled holders. The animals were then sacrificed; lymphoma cells were withdrawn and titrated into adult female LAF_1 mice. The proliferative capacity of the irradiated tumor cells was evaluated after 8 weeks by observing the percentage of animals developing ascites tumors. Surviving fractions were then calculated from LD_{50}'s of control and irradiated animals. Radiation doses in the plateau region were measured with LiF dosimeters calibrated against cobalt-60 gamma rays. Peak doses were calculated from those at the plateau, using a measured average peak-to-plateau ionization ratio of 1.5. Doses in the plateau region ranged from 145 to 250 rads; doses in the peak region ranged from 220 to 380 rads. The survival curve for cells irradiated in the peak region gave a D_0 of 65 ± 15 rads. The plateau points were not reliable. A replicate experiment was performed with ^{60}Co gamma rays, yielding a survival-curve D_0 of 350 ± 50 rads. If the gamma-ray D_0 is taken as a base line, an RBE of 5.4 ± 1.8 is obtained for negative pions in the peak region, based on the ratio of peak-region D_0 to ^{60}Co D_0. (auth)

31221 EFFECTS OF X-IRRADIATION ON THE PROLIFERATION OF CELLS IN PERIPHERAL NERVE DURING WALLERIAN DEGENERATION IN THE RAT. Cavanagh, J. B. (Inst. of Neurology, London). Brit. J. Radiol., 41: 275-81(Apr. 1968).

The changes in nuclear populations in the rat sciatic nerve after crush injury were determined, both in normal animals and at various times following x irradiation with doses from 200 to 2,000 rad. It was shown that definite changes were detectable at seven days after crush following 200 rad and these increase with increasing irradiation doses. At 14 days the populations after 200 and 500 rad returned to normal levels. After 1,000 and 2,000 rad a marked difference from normal existed. The effects persisted substantially unchanged for at least six months. (auth)

31222 EFFECT OF WHOLE-BODY X IRRADIATION ON THYROID FUNCTION IN THE MOUSE. Song, Chang W.; Evans, Titus C. (Univ. of Iowa, Iowa City). Radiat. Res., 33: 480-9(1968).

The effect of whole-body x irradiation with an exposure of 1000 R on thyroid function in mice was studied. The rate of thyroid ^{131}I uptake in the irradiated animals was lower than that in the controls on the second day postirradiation. The radiochromatographic study of thyroid tissue hydrolyzates showed gradual suppression of thyroid hormone synthesis after irradiation. The initial 6-hour conversion ratio of plasma ^{131}I was lower in the irradiated animals than in the controls. There was a temporary retardation in the thyroid hormone secretion after irradiation. From these experiments, with the additional support from the previous literature, it was concluded that a whole-body exposure of mice with 1000 R of x rays acted as a stressor to reduce the various aspects of thyroid function during six to 48 hours after the exposure. (auth)

31223 EPITHELIAL CORDS AND TUBULES OF THE RAT THYMUS: EFFECTS OF AGE, SEX, CASTRATION OF SEX, THYROID, AND OTHER HORMONES ON THEIR INCIDENCE AND SECRETORY ACTIVITY. Cherry, C. P.; Eisenstein, R.; Glucksmann, A. (Strangeways Research Lab., Cambridge, Eng.). Brit. J. Exp. Pathol., 48: 90-106(Feb. 1967).

Effects of x radiation on the histology of the rat thymus were studied in experiments designed primarily to test the influence of the endocrine status of the animals and of additional hormonal treatments on the induction of cancers by the local application of 9,10-dimethyl-1,2-benzanthracene. Treatment with 200-KV x rays was given either as whole-body exposures (5 × 400 R in 16 weeks) or in the pelvic region (6 × 400 R in 20 weeks). The effect of methylthiouracil, thyroxine, cortisone, growth hormone, insulin, alloxan, and irradiation on the incidence of epithelial cords and tubules was also studied. Irradiation of the pelvis in castrate females did not affect either the lymphoid or the epithelial components of thymus. Whole-body exposure of castrate females at a mean age of 282 days caused a marked diminution of volume of the thymus, appreciable reduction of all epithelial structures, and complete disappearance of small tubules. In intact females of mean age 644 days, whole-body exposures to x rays shrank the volume of the lymphoid thymus, but did not decrease the incidence of epithelial structures. Aging, by itself, may have counteracted the action of x rays as was found with methylthiouracil. Testosterone inhibited and estrogens stimulated the development of cords and tubules. Methylthiouracil and cortisone, as did whole-body irradiation, had an inhibiting and L-thyroxine a stimulating effect on the epithelial structures but their action was modified by sex, castration, and age of the animal. The function of the epithelial structures is unknown but the variations in their size with respect to sex, castration, and sex hormones parallel known correlations between sex, endocrine status, and immunologic responsiveness. (BBB)

31224 EFFECT OF BETA IRRADIATION ON THE RABBIT EYE. II. LONG-TERM OBSERVATIONS ON THE EPITHELIUM OF THE LENS AND CILIARY BODY, AFTER ^{90}Sr BETA IRRADIATION, WITH THE ELECTRON MICROSCOPE. Usui, M. (Tottori Univ., Japan). Nippon Ganka Kiyo, 16: 189-207(Feb. 1965). (In Japanese).

Epithelial cells of the lens and ciliary body of rabbit eyes, irradiated with various doses (3240, 6480, 12,960, and 19,440 rep) of ^{90}Sr β rays, were examined with the electron microscope at 19- or 22-month intervals after irradiation. Significant changes in the epithelial cells and young fibers of the equatorial zone of the lens consisted of numerous vacuoles in the cytoplasm, destruction of the nuclei, and marked separation of the cell membranes. In the posterior subcapsular region, isolated cells were noted which were in an impaired state of cellular function because of a marked decrease in the number of mitochondria, endoplasmic reticulum, and other cellular components. It could be that these cells corresponded to the so-called pseudo-epithelium which had been observed with the light microscope. In some lenses irradiated with 6480 rep, recovery of the fine structures of injured cells of the lens was noted, with the disappearance of the numerous vacuoles which were observed at the equatorial zone of the lens at the early stage postirradiation. Changes in the fine structures of the epithelial cells of the ciliary body were associated with the formation of large spaces between the nonpigmented and pigmented epithelia and vacuoles in the cytoplasm of the latter 2½ hr to four days after irradiation. These changes in the epithelial cells of the ciliary body were evidently reversible with the maximum dose of 19,440 rep of β irradiation. (BBB)

31225 EFFECTS OF FOCUSED LASER RADIATION ON DENTAL ENAMEL. Freden, Hakan; Hedin, Anders; Malmberg, Ester-Maria; Mannerberg, Fritz; Roeckert, Hans; Tengroth, Bjoern. Odontol. Tidskr., 74: 303-6(Dec. 20, 1966).

Human tooth enamel was irradiated with focused laser beams using varied and well-defined pulse data which were correlated with the sizes of the craters obtained. The teeth were irradiated intact or coated with carbon. To grade the results the diameter of the craters produced by the laser beams were measured. Four different types of lasers were used and with each laser a minimum of five intact teeth and five carbon-coated teeth were irradiated. The ruby laser beams (lasers A and B) were focused through a microscope with a focal distance of 8 cm. The radiation from neodymium lasers (lasers C and D) was focused through a simple convex lens with 9 mm focal distance. The energy outputs of lasers A, B, C, and D were 110 mJ, 1.0 J, 0.9 J, and 2.7 J, for durations of 2, 500, 0.035, and 800 μsec, respectively. After irradiation with laser A a measurable cavity on intact enamel was noted in only one of 11 teeth. On carbon-coated enamel the corresponding value was two out of six. The mineralization in ground sections of teeth irradiated with laser A was studied with contact microradiography. No differences in the enamel under the crater could be detected. Radiation from lasers B, C, and D produced visible craters only on carbon-coated enamel, when examined under a stereomicroscope. The diameter of the craters varied from 40 μ to 1.5 mm. It was evident that carbon coating increased radiation damage to the underlying enamel. Laser B operated at a higher energy level than laser A. Comparison of the results on carbon-coated enamel in the experiments with these two lasers showed that the beam from laser A caused small craters in two of six samples while laser B produced larger craters in all samples. The radiation from both laser B and C, in the 1-J range, produced craters of the same magnitude. Laser D operated at a higher energy output level but a lower peak power level than laser C, with the same energy input. The craters obtained with laser D were greater than those obtained with laser C. Thus, in the irradiation of dental enamal by focused pulsed laser beams, the energy level of the pulsed output is proportional to the size of the craters obtained. Neither the wavelengths of the light nor the peak power level had any influence. (BBB)

31226 EFFECTS OF PREVIOUS LOCAL IRRADIATION ON THE REGENERATIVE CAPACITY OF STRIATED SKELETAL MUSCLE. **Reznik, M.; Betz, E. H. (Univ. Liege, Belg.). Pathol. Eur., 2: 69-80(1967). (In French).**

In rabbits a single 1500-R dose of 200-kV x rays was given to one hind leg while the other one was protected by a Pb shield. Four hr, one, three, six, and ten days later the anterior tibial muscle of each leg was made ischemic by ligation of the blood vessels supplying it. The paired ischemic muscles were examined histologically two to ten days later for evidence of regenerative ability. In R3a mice similar experiments were carried out with 750- and 1500-R x ray doses, but necrosis was produced, by freezing the muscles with dry ice, rather than ischemia. In both mouse and rabbit, a single local irradiation of 750 or 1500 R induced a latent lesion in the striated muscle. This lesion was evident when the muscle was induced to regenerate after a delay varying from four hr to ten days after the irradiation. Under these conditions the muscle regeneration was largely inhibited by the previous local irradiation. The technique used made it possible to compare in the same animal the regeneration of the normal muscle and the previously irradiated muscle. (BBB)

31227 EFFECT OF WHOLE-BODY AND EXTRACORPORAL X IRRADIATION ON THE LYMPHOCYTES OF THE PERIPHERAL BLOOD. **Waubke, R.; Gerstmair, G.; Trepel, F.; Pichlmaier, H.; Begemann, H. (Staedtische Krankenhaus, Munich). Haematologia (Budapest), 1: 45-60(1967). (In German).**

Various reactions of rat lymphocytes to x irradiation are discussed. A study of the detailed morphological differentiation that was produced is also reported. The lymphocytes were arranged into six subgroups on the basis of size and cytoplasmic or nucleolar staining techniques. Other cell groups, including monocytes, lymphomonocytes, and granulocytes were also studied. Whole-body irradiation consisted of a single dose of 500 or 550 R of 250 KV x ray. The extracorporal irradiation was administered to blood in a 4 ml volume shunt between the carotid artery and the jugular vein. In all, about 75% of the total blood volume of the rats was x irradiated extracorporally with a single dose of 1000 R of x ray, administered over an interval of 20 to 25 min. The bodies of these rats were shielded with Pb. After whole-body irradiation the lymphocytes in the peripheral blood with basophilic cytoplasm regenerated more rapidly than those with clear cytoplasm. After extracorporal irradiation the basophilic lymphocytes were not greatly diminished in number while the number of lymphocytes with clear cytoplasms dropped. (BBB)

31228 EXPERIMENTAL STUDIES ON THE MECHANISM OF RADIATION PROTECTION AND RECOVERY USING SPLEEN SHIELDING. **Ito, Kazuro (Hiroshima Univ.). Hiroshima Daigaku Igaku Zasshi, 15: 555-86(July-Aug. 1967). (In Japanese).**

Hematological and pathological observations were made on the recovery process after x irradiation in spleen-shielded mice and isologous bone marrow transplanted mice. The stathmokinetic index of cultured rabbits' bone marrow cells after irradiation with or without spleen shielding was also observed using roller tube cell suspension methods. The survival rate of the spleen-shielded group and the bone marrow-transplanted group of C_3H female mice exposed to 800 R whole-body irradiation was 89.4% and 95.5%, respectively, compared with 3.9% in the irradiated control group. Although the survival rate of the spleen-shielded group was slightly lower than that of the bone marrow transplanted group, the decrease of the nucleated cell and mitotic cell counts in the bone marrow after irradiation was less and the recovery more rapid in the former group than in the latter group. However, after the recovery a decrease in mitotic cell count was observed in the spleen-shielded group. The myelogram showed no difference between the two groups, but lymphocyte counts of the spleen-shielded group showed a smaller decrease than the bone marrow transplanted group, and recovery was more rapid in the spleen-shielded group. Pathological findings revealed conspicuous changes, such as a decrease of lymphocytes in the spleen of the spleen-shielded group and enlargement of the sinuses of femoral bone marrow in the bone marrow transplanted group in the recovery period. The stathmokinetic index of cultured rabbits' bone marrow cells 1 hr after irradiation showed a prominent increase in the spleen-shielded group, but at 24 hr it showed a decrease of the same degree as in the control group. It was difficult to explain the mechanism of spleen shielding against radiation injury by the cellular theory, and a more rational explanation might be based on the humoral theory. (BBB)

31229 FAILURE OF CHINESE HAMSTER CELLS TO REPAIR SUB-LETHAL DAMAGE WHEN X-IRRADIATED IN THE PLATEAU PHASE OF GROWTH. **Hahn, G. M. (Stanford Univ., Palo Alto, Calif.). Nature (London), 217: 741-2(Feb. 24, 1968).**

Ability of exponentially growing Chinese hamster cells to repair sublethal damage induced by X-irradiation has been demonstrated. It seems, however, that cells under crowded culture conditions progressively lose their repair capacity, even in the absence of specific inhibitors. Studies are described providing evidence for this, employing whole and fractionated irradiation doses to cells in plateau phase. When the cells were subcultured and re-seeded in less crowded environments, the repair capacity of surviving cells was restored. (UK)

31230 FIBROBLASTS IN STERILE INFLAMMATION: STUDY IN MOUSE RADIATION CHIMAERAS. **Barnes, D. W. H. (Medical Research Council, Harwell, Eng.); Khrushchov, N. G. Nature (London), 218: 599-601(May 11, 1968).**

Two sources have been suggested for the origin of fibroblasts found in an inflammatory area. Some authors support the idea of an origin from circulating mononuclear blood cells, while others consider that such areas also originate from local sources. This problem was investigated using syngeneic mouse radiation chimaeras prepared with the cytological marker T6 to distinguish cells of host and donor origin. The results indicated that fibroblasts are derived from myeloid tissue, and that macrophages as well as haematopoietic and lymphatic tissues arise from transplanted "stem cells." (UK)

31231 FIBROSARCOMA FOLLOWING RADIATION THERAPY. **Schwartz, Emanuel E.; Rothstein, Jerry D. (Univ. of Virginia, Charlottesville). J. Amer. Med. Ass., 203: 296-8(Jan. 22, 1968).**

Fibrosarcoma involving the rib cage occurred 15 years after a woman had undergone x radiation therapy for breast carcinoma. It is important to maintain a proper perspective regarding the danger vs the value of judicious radiation therapy. (auth)

31232 FOCAL HEPATIC INJURY AND REPAIR PRODUCED BY LASER RADIATION: PATHOLOGIC AND BIOPHYSICAL STUDIES. **Fine, Samuel (Northeastern Univ., Boston); Edlow, Jules; MacKeen, Donald; Feigen, Larry; Ostrea, Enrique; Klein, Edmund. Amer. J. Pathol., 52: 155-76(Jan. 1968).**

Since the abdominal muscle of the young rat had optical properties, if the skin was first reflected, pulsed laser radiation at 6943 Å could be transmitted through the intact abdominal muscle to produce an in situ focal hepatic lesion. This was accomplished without physically exposing the peritoneal cavity, and with minimal gross injury to the overlying muscle. Pulsed ruby laser radiation was thus used to form a localized and well-defined hepatic lesion for study of the histologic response of liver tissue to this type of injury. The nature, site, extent, and geometry of the lesion were correlated with the biophysical factors involved. Some of the thermal and optical events occurring in the abdominal muscle and liver during laser radiation were described to relate these events to the genesis of the lesion, along with the initial and evolving gross and histopathologic changes of the lesion. The use of this technique offered advantages in the study of in vivo hepatic necrosis, autolysis, and repair. (BBB)

31233 HISTOLOGICAL STUDIES ON THE ADRENAL CORTEX BY RABBITS FOLLOWING WHOLE-BODY X IRRADIATION. Kadobayashi, Sanjuro (Osaka City Univ.). Nippon Ganka Kiyo, 17: 133-9(Feb. 1966). (In Japanese).

Histochemical and histological studies were made on the adrenal cortex of rabbits exposed to a single whole-body x-irradiation dose of 600 R, the head being shielded. A second group received 600 R in two equally divided doses with an interval of 2 hr. The third group was restrained for the same time (32 min) as required in the first group for irradiation (sham irradiation). Changes in the first group which were observed included vacuolation of the cytoplasm in the cortical cells, pyknosis, and irregularity of the cell arrangement in the zona fasciculata 12 hr after irradiation. Twenty-four hr later the zona glomerulosa showed transformation to a fascicular-type structure and the zona fasciculata was considerably hypertrophied. Three days later, hypertrophy of the whole adrenal cortex, with scattered degenerative cells and decrease in lipid contents, was noted. Seven days later these changes were still evident. Changes in the second group included a slight atrophy of cortical cells in the zona glomerulosa and irregularity of cell arrangement in the zona fasciculata 12 hr after irradiation. Twenty-four hours later, degenerative changes and a zig-zag-like formation with lipid depletion of the cortex were found. In the third (control) group no notable changes were observed in the adrenal cortex either 12 or 24 hr after irradiation. (BBB)

31234 IN VITRO STUDIES OF SKIN AFTER IRRADIATION BY A RUBY LASER. Lawrence, J. C. (Birmingham Accident Hospital, Eng.). Brit. J. Plast. Surg., 20: 257-62(July 1967).

Changes in the metabolic activity and histology of albino guinea pig skin slices after exposure to light from a ruby laser were investigated in tissue culture. A graded response to laser radiation was demonstrated by measurement of respiration and uptake of radiosulfate into skin mucopolysaccharide. The ED$_{50}$ of both dose-response curves was about 2 J/mm^2. Histologic studies suggested that the laser did not selectively destroy any particular zone of the skin. High-energy radiation densities were necessary to produce an immediate effect; these doses resulted in an explosive disintegration of the tissue. Laser energy levels causing damage to skin slices in vitro were comparable with those reported earlier. It was thought that damage to skin by laser radiation was due to heat. If damage was caused by alternative mechanisms, such as molecular disruption due to resonance in the intense magnetic field produced by the powerful light, it would probably occur at a particular energy threshold and not necessarily produce a graded response. (BBB)

31235 IRRADIATION SYMPTOMATOLOGY IS DETERMINED BY DEVELOPMENTAL STAGE. Morgan, W. C. (South Dakota State Univ., Brookings). pp 531-5 of Proc. 13th World's Poultry Congr., Kiev, USSR, 1966.

The changes produced by ^{60}Co γ irradiation in the chicken embryo at different developmental stages were studied. It was found that specific responses occurred at predictable age levels. White Leghorn eggs at various developmental stages were treated with 200, 500, and 1000 R. The two lower dosages did not affect hatchability, but 1000 R was lethal to embryos which were treated during the first four days of development. All eggs which were treated from zero to ten days embryonic age required an extended hatching time or exhibited high mortality. The 1000 R dose was highly lethal to embryos which were less than five days old when treated. Incapacity and chick mortality of the five-, six-, and seven-day groups resulted in less than 50% survival. The most conspicuous anomalies were toe-curling in 24 of the 26 chicks which hatched in the five-day group and toe-nail absence in the six-day group. The toe-curling anomaly was similar to the defect caused by riboflavin deficiency. Response differences at progressive embryonic ages made it possible to identify the LD$_{50}$ for a biological material subjected to a constant 1000 R dose. Five-day embryos showed an "effective" LD$_{50}$ limited to prehatching lethality. Eight-day embryos were subjected to a "facultative" LD$_{50}$; half of the eggs hatched into healthy, surviving chicks. Death at the approximate time of treatment occurred only in the one- to four-day incubated eggs. It was concluded that in addition to the circulatory disruption occurring at early embryonic ages and the digital reduction which was cellularly controlled, there was a physiological change induced by irradiation at the critical five-day embryonic age. This change may result from enzymatic inhibition, vitamin inactivation, toxin production, or some other mechanism. (BBB)

31236 INFLUENCE OF A MIXTURE OF RADIOPROTECTORS ON THE MUCOSA OF THE SMALL INTESTINE OF MICE IRRADIATED WITH 2000 R OF X-RAY. Maisin, J. R.; Lambiet-Collier, M. (Centre d'Etude de l'Energie Nucleaire, Mol, Belgium). Experientia, 24: 338-9(Apr. 15, 1968).

Results on the number of nuclei, pycnoses, karyorrhexis and mitoses in protected irradiated mice demonstrated that mixtures of chemical protectors largely diminished the lesions produced in the stem cells of the duodenum of mice irradiated with 2000 R of x rays, but a delay of about 30 days is nevertheless needed to allow complete recovery of the duodenal mucosa. (auth)

31237 LATE SOMATIC EFFECTS IN FEMALE RF/Un MICE IRRADIATED WITH SINGLE DOSES OF 14-MeV FAST NEUTRONS. Darden, E. B. Jr.; Cosgrove, G. E.; Upton, A. C.; Christenberry, K. W.; Conklin, J. W.; Davies, M. L.; Gosslee, D. G.; Kastenbaum, M. A. (Oak Ridge National Lab., Tenn.). Int. J. Radiat. Biol., 12: 435-52(Oct. 12, 1967).

RF/Un female mice ($\sim$1700 animals), 10 to 11 weeks old, were given a single whole-body irradiation with 14 MeV neutrons (either 0, 50, 100, 200, or 400 rads) at a dose-rate of 1 to 2 rads/min. The mean age at death for 30-day survivors decreased with increasing dose. The incidence of thymic lymphoma and of myeloid leukemia increased with dose. The incidence of ovarian tumors increased with dose to a maximum at 100 rads. Radiation enhanced the decline in hematocrit with age. Lens opacities developed in all irradiated groups by three months after exposure, progressed at a dose-dependent rate, and ultimately attained a level of severity that greatly exceeded any senile changes in the controls. Other common non-neoplastic diseases were not increased in incidence by irradiation, but all occurred earlier in irradiated animals. The results suggested that 14 MeV neutrons were more effective than γ rays for shortening life and for producing lens opacities but not necessarily for inducing neoplasms, depending on the neoplasm in question. (auth)

31238 LATE ULCERATIVE ROENTGENODERMA, COMPLICATED BY SARCOMA. Rakhmanov, V. A.; Potekaeva, M. A.; Romanenko, G. F. (First Moscow Medical Inst.). Arkh. Patol., 30: 59-62(1968). (In Russian).

A patient, 71 years of age, who had been exposed to x radiation during treatment for eczema of the hands is described. Early radiation injuries developed as a result of overdosage; then a late ulcerative roentgenoderma developed on the dorsal surface. The left hand was amputated 11 years after the onset of the disease. After 23 years a tumor developed on the right hand, which proved to be of hemangiosarcoma character (histological and histochemical examination). (auth)

31239 LOW DOSES OF RADIATION AND REMOTE EFFECTS. Moskalev, Yu. I.; Streltsova, V. N. Med. Radiol., 12: No. 10, 53-8(Oct. 1967). (In Russian).

One of the most complex and important problems of modern radiobiology—the assessment of levels and range of low doses of radiation, is discussed. Attention is drawn to the necessity of differentiation of the term low dose for different reactions of the organism on the level of cell, tissue, and body. The authors inquire into the possible approaches and give an assessment of the levels of low doses for a number of tumorous and nontumorous forms of remote effects, including cirrhosis of the liver, nephrosclerosis, tumors of the bones, hematopoietic tissue, gastrointestinal tract, kidneys, testes, mammary glands, thyroid gland and hypophysis in injury with radioactive isotopes, neutrons and protons. (auth)

31240 MATHEMATICAL ANALYSIS OF THE DIVISION DELAY PRODUCED BY IONIZING RADIATIONS. Sacher, George A. (Argonne National Lab., Ill.). Radiat. Res., 33: 644-58(1968).

Recent advances in knowledge about the relation of division delay to dose invalidate Lea's linear model of the recovery process. Since the present evidence is that delay is a straight-line function of dose, the first model considered is one postulating zero-order recovery kinetics. Although this yields a straight-line delay/dose relation, it is inconsistent in other respects. Lea's first-order model is reexamined and shown to lead to a logarithmic delay/dose relation which fails to fit the data for synchronized cell populations. A model is next considered in which the rate of recovery depends on the amount of uninjured biosynthetic substances remaining after irradiation. This model leads to second-order kinetics and a logistic recovery function. It is shown that this model yields a straight-line delay/dose relation and consistent estimates of the injury and recovery parameters. This second-order model is fitted to data for mammalian cells in culture and for vegetative division of Paramecium aurelia. This model does not fit data for cleavage of fertilized Arbacia eggs, but it is pointed out that marine eggs have great reserves of material, and hence are different from cells in a steady state of synthesis and division. It is concluded that the second-order model fits the data appreciably better than do the other models considered. (auth)

31241 MEASUREMENT OF THE PROTON DOSE OF GEMINI ASTRONAUTS WITH NUCLEAR EMULSION. **Schaefer, Hermann J. (Naval Aerospace Medical Inst., Pensacola, Fla.). Biophysik, 4: 63-76(1967). (In German).**

Small film packs with nuclear emulsions were carried on the Gemini flights of the astronauts directly next to the body under the spacesuit. The evaluation of the track traces in Ilford-G5 and K2 emulsion pairs permits an accurate determination of the flux and energy loss spectrum and therefore the dose of proton radiation that the Gemini capsule encountered in flight through the south Atlantic part of the radiation belt. In spite of the strong prefiltering in the capsule wall and other materials in the capsule the radiation at the measuring site in the emulsion is detected as very soft. More than 40% of the site dose in the emulsion is produced by protons of a range of less than 1 mm tissue. As a result of this spectral composition great variation in the radiation peak in the capsule is obtained. The dose to each of three measuring sites directly on the astronauts in the 14-day Gemini flight varies from 159 to 233 mrad. The electron and γ backgrounds appeared very low but were not determined separately. The dose contribution of heavy nuclei was determined by estimation of the atomic number using a comparison scale and was smaller than 10 mrad. It appears difficult to establish the true radiation burden and the maximum permissible dose for whole body radiation in such bazaar radiation fields as were obtained from the measurements. (tr-auth)

31242 MORTALITY AND CAUSES OF DEATH IN X-RAY TECHNICIANS. **Kitabatake, T.; Komiyama, K. Ind. Med. Surg., 36: 135-8(Feb. 1967).**

A survey was carried out in three prefectures in Japan to determine the cause of death and age at death of x ray technicians who had died between 1933 and 1963. The results showed that the age-corrected death rate in x ray technicians was higher than that for the general Japanese male population. The breakdown of cause of death was nearly the same as in the general Japanese male technical worker population, but the corrected death rates from all causes were slightly higher. Skin cancer tended to occur more frequently in x ray technicians than in the general population, but leukemia was not frequent in x ray technicians. Life expectancy for male technicians at 20 years of age was 5 years less than for the general Japanese male technical worker population and this corresponded to a reduction in life expectancy at 20 years of age of 0.68 days per rad. It was calculated that the average dose received by the 47 deceased technicians whose histories were used for the life table given in the study, was 2633 rads. (Occup. Safety and Health Abstr.)

31243 OBSERVATIONS ON THE EFFECTS OF γ RADIATION ON EGGS OF THE DESERT LOCUST, SCHISTOCERCA GREGARIA (FORSK.). **Hunter-Jones, P.; Haskell, P. T. (Anti-Locus Research Center, College House, London). Bull. Entomol. Res., 56: 725-35(Aug. 1966).**

To provide data for evaluation of the possibility of using ionizing radiation for locust control, some experiments on the effect of ^{60}Co γ radiation on eggs of the desert locust were performed. After a single dose of radiation, mortality among the eggs was correlated with the size of the dose and the age of the egg at irradiation. The dose required to kill the older eggs was 40 times greater than that required to kill young eggs; thus, 144 rad caused almost complete inviability among eggs deposited one or two days before irradiation, but a dose in excess of 5500 rad was required to kill eggs deposited 11 days earlier. For comparison, the lethal dose of γ radiation for mammals is 400 to 900 rad. When the dose was applied in three small fractions (3×72 rad 1 hr apart), the percentage of eggs killed was less than when the same total dose was given in one exposure. This difference was presumably due to tissue recovery during the inter-radiation periods. The temperature to which the eggs were exposed during the inter-radiation periods also affected survival, recovery being greater at higher temperatures. The possibility of using γ radiation to control locust egg-fields, cost of the equipment needed, and hazards involved are discussed. It is concluded that control by this method offers no advantage in terms of cost, effectiveness, or convenience as compared with conventional insecticide treatment and would be impractical and dangerous to operators and the inhabitants, human and domestic animal, of the treated area. However, other control techniques utilizing radiation, such as sterile-male release, may be useful against certain species of locusts. (BBB)

31244 OSTEOCARTILAGENOUS EXOSTOSES RESULTING FROM IRRADIATION. **Borghi, A.; Manzoni, A. (Univ., Bologna). Radiobiol. Radioter. Fiz. Med., 22: 168-78(May-June 1967). (In Italian).**

Four cases of osteocartilaginous exostoses at the site of previous superficial therapeutic irradiation are described. It was concluded that these formations were due to the damaging action of irradiation on the growth of cartilage. Pathogenic mechanisms are discussed. (C.H.)

31245 ON THE REFLEX ACTION OF CYSTAMINE UPON CERTAIN FUNCTIONS BEFORE AND AFTER IRRADIATION. **Lapshin, N. A. (Military Medical Academy, Leningrad). Farmakol. Toksikol., 31: 97-8(Jan.-Feb. 1968). (In Russian).**

Orally administered cystamine acted on intestinal and splenic chemoreceptors of nonirradiated cats to produce a reflex rise of blood pressure, higher respiration rate, and deeper breathing. After a Novocaine (0.25%) solution was administered and acted on the intestinal and splenic receptors, the repeated administration of cystamine failed to evoke reflex changes in the cardiovascular and respiratory responses. With the injection of cystamine into the bloodstream, a different pattern of effects from that of cystamine given orally was seen. Comparison of the reflex actions evoked by cystamine and acetylcholine revealed some superficial similarity in the final effects. Both agents when acting on the receptors caused a pressor reaction after a brief latent period. Prolonged and repeated use of cystamine gradually led to a decreased magnitude and a changed nature of the reflex responses and, finally, to their extinction. When cystamine given orally was tested on intestinal and splenic chemoreceptors of cats on the 1st and 2nd day following 600 R x irradiation, the intensity of the reflex reactions increased in 85% of the experiments and a much slower development of the reflex reaction was observed in 15%. On the 5th and 7th day after irradiation, the animals treated with cystamine also showed a decreased magnitude and altered response. This was followed by a complete extinction of reflexes on the 14th to 16th day after irradiation. (BBB)

31246 PERMANENT RADIATION MYELOPATHY. **Locksmith, John P.; Powers, W. E. (Mallinckrodt Inst. of Radiology, St. Louis). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 102: 916-26(Apr. 1968).**

Six cases of radiation myelopathy occurring as a complication of radiation therapy of inoperable carcinoma of the lung are reported. The segment of the thoracic spinal cord irradiated was greater than 10 cm. in all patients. The dose to the spinal cord was in the range of 4,000 rads in three weeks, given in approximately equal fractions five times a week. All treatments were done on an Allis-Chalmers betatron operating at 22.5 MeV. The treatments were equally given through anteroposterior and posteroanterior opposing ports. The incidence of radiation myelopathy in the series of 48 one year survivors was 12.5%. Because of this complication, the treatment plan was modified. (auth)

31247 POST-RADIOTHERAPEUTIC SARCOMAS. **Paunier, J.-P.; Candarjis, G. (Univ. de Radiologie Medicale, Lausanne, Switzerland). Radiol. Clin. Biol., 36: 249-52(1967). (In French).**

Post-radiotherapeutic sarcomas are rare, but they have a great theoretical interest. Three cases of fibrosarcomas probably resulting from therapeutic exposure to x radiation are described. The first was in a young man irradiated on the basis of an erroneous diagnosis of osteosarcoma. He developed a fibrosarcoma in the irradiation field 8 years later. The second was a fibrosarcoma of the back appearing 14 years after preventive irradiation of the spinal cord for cerebellar medulloblastoma. The third is a fibrosarcoma of the clavicle region appearing 6 years after preoperative irradiation for a carcinoma of the breast. (tr-auth)

31248 QUANTITATIVE ASPECTS OF HEMATOLOGICAL EFFECTS OF IONIZING RADIATION. **Le Go, Roland (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France). Radioprotection, 1: 89-106(1966). (In French).**

Before examination of the quantitative aspects of hematological effects, the structure of biological dosimetry is outlined and the kinetics of its functioning are briefly described. The mechanism of the response is defined and the methods used to measure the response are described. The hematological responses themselves are then outlined. Typical evolution curves following irradiation are given and discussed. (J.S.R.)

31249 QUESTION OF THE RECOVERY PROCESSES IN PROLONGED IRRADIATION OF RESEARCH ANIMALS WITH X RADIATION. **Heuss, K. (Max-Planck-Institut fuer Biophysik, Frankfurt am Main). Biophysik, 4: 146-54(1967). (In German).**

Mice were exposed to irradiation with x rays during their entire life span (either continuously or to fractionated doses with a total dose of 2.5 R/day). The shortening of the life span observed was dependent on the total accumulated dose and not on the fractionation schedule or the instantaneous dose rate. There were no indications of recovery processes. The higher dose needed in long-term irradiations for the same life shortening as in short-term irradiation can be explained from the age dependence of the specific life shortening. (tr-auth)

31250 RADIATION EFFECTS ON A CONDITIONAL CELL RENEWAL SYSTEM UNDER CONTINUOUS LOW DOSE-RATE EXPOSURE. Fabrikant, Jacob I. (Inst. of Cancer Research, Surrey, Eng.). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 102: 811-21(Apr. 1968).

The response of the cell renewal systems of the body to continuous low dose-rate γ irradiation appears to be a consequence primarily of the difference in dose-rate at which a steady or near-steady state of cell population can be established at a lower population level and can maintain essential function. It appears that accumulation of cellular radiation damage from generation to generation is not a very significant effect in rapidly dividing cell systems, such as bone marrow, due to the selection-out of damaged cells at division. In conditional cell renewal systems under continuous whole-body γ irradiation, such as the slowly dividing liver cell population in rats, the selection-out of damaged cells was less efficient. However, in spite of the accumulation of relatively large radiation doses and in the presence of considerable cellular radiation damage, the pattern of cell proliferation during regeneration after partial hepatectomy did not appear to be seriously affected by prior continuous exposure. Such tissues with cells of long intermitotic times apparently can accumulate very large radiation doses under continuous irradiation and still retain adequate proliferative capacity in a demand situation, such as the liver after partial hepatectomy. Homeostatic mechanisms which influence the speed and efficiency of regeneration following injury under continuous irradiation apparently can operate effectively to reduce the deleterious effects and to repair radiation damage, either by intracellular mechanisms or by the selection-out of damaged cells at mitosis. (C.H.)

31251 RADIATION CARCINOGENESIS. Mayneord, W. V. Brit. J. Radiol., 41: 241-50(Apr. 1968).

The probability that the creation of an ion-pair in a cell results in the appearance of a clinically identifiable tumor in the individual bearing that cell is discussed in the context of other complex factors involved. Modern concepts of carcinogenesis, the idea of "critical volume," and the effects of radiation dose are discussed. Mathematical models of radiation carcinogenesis are presented. In conclusion the author summarizes his present position on carcinogenesis. (M.M.B.)

31252 RADIOPROTECTIVE EFFECTS OF DIMETHYL SULFOXIDE VAPOR ON MICE. Moos, W. S.; LeVan, H.; Mason, H. C. (Univ. of Illinois, Chicago. Arkansas State Hospital, Little Rock). Experientia, 23: 923(Nov. 15, 1967).

Three groups of mice were x-irradiated; the first group (control) was exposed to water vapor, the second to dimethyl sulfoxide (DMSO) vapor, and the third to nembutal dissolved in DMSO. The mortality of the control group was significantly higher than that of the experimental groups. (H.L.W.)

31253 RADIATION EFFECT ON THE MICROCIRCULATION; RELATION TO EARLY MORTALITY IN THE CHICK EMBRYO. Stearner, S. Phyllis; Christian, Emily J. B. (Argonne National Lab., Ill.). Radiat. Res., 34: 138-52(1968).

Exposure of the chicken and chick embryo to lethal levels of ionizing radiation resulted in a circulatory failure and early mortality (<24 hours). This injury response, previously characterized in relation to physical factors of the experiment (dose, dose rate, and time), involved a circulatory collapse that resulted from increased vascular permeability and degenerative changes of the vascular endothelium. These effects, leading to circulatory stasis and death, were observed and recorded cinemicrographically in irradiated chick embryos. After 66 to 68 hours of incubation, embryos (including the entire area vasculosa) were explanted onto an agar-albumen medium and subjected to 250-kv x-ray exposures of 700 R or 1100 R, delivered in 12 minutes. These exposures resulted in 10% or 90% mortality, respectively, within 24 hours. Circulation in chick embryos exposed to 700 R was similar to that in nonirradiated controls. After exposure to 1100 R, the hemoconcentration observed within 30 to 45 minutes suggested a plasma loss. In localized areas circulating cells adhered to the endothelium, and thrombi formed. Vascular degeneration progressed until stasis became complete, frequently within 4 to 6 hours after exposure. A movie, illustrating these findings, is available upon request. Order movie by title and number: ANL-MP-730-153. Early changes in the microcirculation in the x-irradiated chick embryo. Argonne National Laboratory, Film Center, D-2-149, 9700 S. Cass Avenue, Argonne, Illinois, 60439. (auth)

31254 RADIATION INJURIES BEFORE 1925. Vacirca, S. J. (State Univ. of New York, Brooklyn). Radio. Technol., 39: 347-52(May 1968).

A brief review of the early literature on radiation injury presents some case histones with description of the symptoms and injuries sustained by workers and patients exposed to x rays and radium beginning with the first reported injury in 1896. In the 1920's published reports on hemopoietic damage to the radium dial painters resulted in a more sophisticated approach to radiation protection. 17 references. (auth)

31255 SOME DIFFICULTIES AND ERRORS IN THE DIAGNOSIS OF CHRONIC RADIATION SICKNESS. Khadzhidekov, G.; Tsochev, Ts.; Mitrov, G. Rentgenol. Radiol., 6: 81-6(1967). (In Bulgarian).

Cases of faulty diagnosis of radiation sickness among medical personnel exposed to the action of ionizing radiation are reported. It is pointed out that individual symptoms and syndromes that are encountered in early stages of radiation sickness may also develop as a result of various infectious diseases, disturbances of the functioning of endocrine glands and of the cardiovascular system, nicotine and alcohol poisoning, physical and mental fatigue, etc. Particular care, according to the authors, should be taken in differentiating between leukepenia due to radiation sickness and leukepenia caused by poisoning with various substances, side effects of drugs, and chronic infections such as tuberculosis, brucellosis, and lues. Unless this is done, and every symptom is regarded in its proper context, an erroneous diagnosis of radiation sickness may easily be made. (JPRS)

31256 SOME FUNDAMENTAL RELATIONSHIPS PERTAINING TO THE DEVELOPMENT OF RADIATION INJURIES. Baisogolov, G. D.; Gus'kova, A. K. Radiobiologiya, 7: 343-9(1967). (In Russian).

A classification of human radiation sickness was proposed in which an attempt was made to correlate clinical manifestations with the magnitude of the dose and its distribution in time and through the volume of the body. It was pointed out that the concept of a critical organ was relevant not only to lesions produced by radiation emitted by isotopes, which on absorption accumulate predominantly in certain organs, but also to injuries that develop from general irradiation. The degree of development of injuries in different organs and systems depended on the dose of external radiation to which the body was exposed. (JPRS)

31257 STATE OF THE TRACHEAL EPITHELIUM AFTER FRACTIONAL ROENTGEN IRRADIATION AND TRACHEOTOMY IN RABBITS. Funshtein, L. V.; Gotlib, Ya. L. Med. Radiol., 12: 31-5(Sept. 1967). (In Russian).

In some diseases of the neck or chest radium therapy leads to unavoidable irradiation of the trachea. To elucidate the influence of radium therapy on the trachea, experiments were conducted on rabbits involving fractional x irradiation of the trachea and subsequent tracheotomy. In operated animals preliminary x irradiation with an exposure dose of 3080 R did not impede planocellular metaplasia of the tracheal epithelium, which was induced by the introduction of a foreign body into the trachea after its resection. Irradiation in a dose of 6100 R caused the formation of a planocellular structure of respiratory epithelium of rabbit's trachea. (auth)

31258 SOME OBSERVATIONS ON THE COMBINED EFFECTS OF X RAYS AND METHOTREXATE ON HUMAN TUMOR CELLS IN VITRO WITH POSSIBLE RELEVANCE TO THEIR MOST USEFUL COMBINATION IN RADIOTHERAPY. Berry, Roger J. (Churchill Hospital, Oxford). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 102: 509-18(Mar. 1968).

The lethal effects of methotrexate upon human tumor cells in vitro depend not only upon the concentration of the drug around those cells, but also upon the length of time for which the drug and the cells remain in contact. Short-term exposure to even very high concentrations of methotrexate may leave a large proportion of tumor cells intact, while longer exposures to lower drug concentrations will leave few cells capable of repeated divisions. Exposure of human tumor cells to concentrations of methotrexate which are nonlethal nonetheless sensitizes those cells to subsequent x irradiation. Tumor cells which survive exposure to higher, cell-killing concentrations of methotrexate are protected less by anoxia than untreated cells when they are irradiated immediately afterwards. When irradiated immediately after exposure to the drug, methotrexate-treated HeLa cells showed no recovery from sublethal x ray damage; if irradiated 24 hours or more after their removal from methotrexate, those tumor cells which had survived were capable of recovery between fractionated x ray doses and showed no reduction in anoxic protection. These results in a relatively simple single-cell system are examined in the context of treatment schemes used in the several published clinical studies of radiotherapy combined with methotrexate chemotherapy. A plan is proposed for the optimum combination of these two agents. (auth)

31259 THE DISSOLUTION OF PROTOPLASM IN THECATE DINOFLAGELLATES BY ULTRAVIOLET-INDUCED OXIDATION. Holmes, Robert W. (Univ. of California, San Diego). Contract AT(11-1)-34. Stain Technol., 42: 34-5(Jan. 1967).

The identification of certain thecate dinoflagellates is based on the arrangement and configuration of plates making up their cell walls. Cell contents must first be destroyed to make details of the cell wall visible. Such cleaning may be carried out in bulk by the oxidation of cellular contents under intense uv light. The uv source employed was a 1200-W Hg arc tube. One ml of cultured cells or natural phytoplankton is diluted to 15 ml, placed in a quartz tube 2 cm in dia and 12 cm long, and 0.1 to 0.2 ml of 30% H_2O_2 added just prior to irradiation. The sample is then subjected to uv light for 1 to 2 hr. The resistance of the thecae or plates of Ceratium, Peridinium, Dinophysis, Prorocentrum, and Goniaulax species to such treatment suggested that the wall has an inorganic as well as organic component. In Goniaulax polyedra and Ceratium the cell wall separated into its constituent plates along the sutures, whereas members of the genus Peridinium tended to remain intact although they also fragmented if handled roughly. (BBB)

31260 THE EFFECT OF PROLONGED ACTION OF LOW X-RAY DOSES ON THE HYPOTHALAMO-HYPOPHYSEAL SYSTEM. Moiseev, E. A.; Konstantinova, M. S. Probl. Endokrinol. Gormonoter., 11: 68-73(July-Aug. 1965). (In Russian).

The effects of daily whole-body x irradiation on the adenohypophysis and the hypothalamo-hypophyseal neurosecretory system of rats was studied at doses of six to ten R a day (min lethal doses). The rats of the first group were sacrificed immediately after the termination of irradiation (total doses ranged from 300 to 800 R). The animals of the second group were sacrificed 3.5 to 9.5 months after the last irradiation (total dose 800 R). With a dose of 100 R signs of activation of acidophil and basophil cells were noted in a study of the functional state of a adenophypophyseal cellular elements. With increase of the dose, activation was replaced by evidence of injury to the cellular elements, especially of the delta basophils. After prolonged periods of survival acidophils became normal. The basophil cytoplasm was homogeneous or contained droplets. Immediately after irradiation at doses of 600 to 700 R the posterior lobe of the hypophysis was filled with neurosecretory material. In animals that survived for a long period of time the neurosecretory system was in a functional resting state. (BBB)

31261 THERAPEUTIC EFFECT OF SEROTONIN ON THE SURVIVAL OF X-IRRADIATED RATS. Rixon, R. H.; Baird, K. M. (Chalk River Nuclear Labs., Ont.). Radiat. Res., 33: 395-402 (1968).

Four equally spaced injections of serotonin (5 mg/kg) during the first hour following exposure to 800 R of x rays was found to increase the survival of rats. This effect was inhibited by a single injection of lysergic acid diethylamide (0.16 mg/kg), a serotonin antagonist, given immediately prior to irradiation. No therapeutic effect of serotonin was observed with one (10 mg/kg) or two (6 or 8 mg/kg) injections, or when the four injections were spaced at hourly intervals. These data suggest that a prolonged and intense vacoconstriction in the vital radiosensitive tissues of animals is basic to the radiotherapeutic role of serotonin. The recovery from lethal radiation damage may be attributable to an hypoxia-induced reduction in cellular respiration. (auth)

31262 THE EFFECTS OF UNILATERAL THORACIC IRRADIATION ON PULMONARY BLOOD FLOW. Teates, Charles D. (Univ. of Virigina, Charlotte). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 102: 875-82(Apr. 1968).

Pulmonary blood flow to the γ-irradiated lung in dogs was studied by the lung scan technique following injection of ^{131}I-human albumin macroaggregates. The flow was markedly reduced by 52 to 109 days following 3,000 R to one lung over five days. Perfusion of the irradiated lung decreased as the pneumonitis stage became apparent on chest roentgenograms, and there was no significant improvement in flow as the pneumonitis cleared, leaving the late fibrotic stage. Mechanisms by which the pulmonary blood flow may be reduced are discussed. (auth)

31263 THE INFLUENCE OF PARTIAL RESECTION AND X IRRADIATION OF THE LIVER ON THE LATENT PERIOD OF CHRYSOIDIN HEPATOMA IN MICE. Rzucidlo, Zbigniew; Szacki, Jerzy; Lawinski, Marek; Grzebieluch, Marek (Medical Academy, Wroclaw. Inst. of Immunology and Experimental Therapy, Wroclaw). Arch. Immunol. Ther. Exp., 15: 877-80(1967).

Partial hepatectomy and irradiation of the whole-body with a single dose of x rays shortened the latent period of transplantable chrysoidin hepatoma in mice. The survival time of irradiated animals inoculated with hepatoma in which the liver was partially resected was shorter than in animals with transplanted hepatoma which were only irradiated. (auth)

31264 THE INCREASED EXCRETION OF TAURINE AND BETA-AMINOISOBUTYRIC ACID IN URINE FOLLOWING IRRADIATION AND THE SENSITIVITY OF THESE BIOCHEMICAL REACTIONS. Bigwood, Edward J. (Univ. Libre, Brussels). Strahlenschutz Forsch. Prax., 4: 183-97(1964). (In German).

The enhanced excretion of taurine and β-aminoisobutyric acid in urine of rats irradiated with 50 R or more was discussed. Data showing concentrations of these metabolites in spleen, lymph nodes, and blood, urinary amino acid patterns, and serum transaminase were presented. The possibility that after irradiation β-aminoisobutyric acid could be derived from a transformation of thymine was conjectured. According to this scheme, thymine was transformed successively to dihydrothymine, β-aminoureidoisobutyric acid, and finally to β-aminoisobutyric acid. (BBB)

31265 THE RADIATION-INDUCED DEFECTS OF THE CENTRAL NERVOUS SYSTEM OF MAMMALS AND OF MAN WITH SPECIAL REFERENCE TO INJURIES OF THE CEREBRUM AND CEREBELLUM. Schmidt, Reiner (Martin-Luther-Univ., Halle, Ger.). Biol. Rundsch., 2: 26-32(1964). (In German).

The prenatal and postnatal radiation injuries of the cerebrum and cerebellum observed in mammals and humans are discussed. The effects of relative time of irradiation on the type and incidence of malformations in mice are illustrated and discussed. The only period when no injuries were produced in mice by irradiation was when the fetus was from zero to nine days old. The discrepancies observed between various studies that were made to produce and evaluate postnatal irradiation injuries in mammals are discussed. Some possible general mechanisms of postnatal injuries are outlined. Even though the mature brain appeared, in comparison to other organs, to be able to tolerate very high doses of irradiation, it was not entirely insensitive to radiation injury. (BBB)

31266 THE ROLE OF THE THYMUS IN THE FATE OF THE ALLOGENIC BONE MARROW TRANSPLANTED TO DOGS IRRADIATED WITH A DOSE OF 1000 R. Chertkov, I. L.; Maksimenko, A. S.; Novikova, M. N.; Raushenbakh, M. O. (Inst. of Hematology and Blood Transfusion, Moscow). Med. Radiol., 12: No. 10, 47-53 (Oct. 1967). (In Russian).

Transplantation of the allogenic bone marrow to dogs exposed to irradiation in a dose of 1000 R and preliminarily thymectomized in adult age is not accompanied by transformation of the introduced hemopoietic cells into lymphocytes. Inference is made therefrom to the effect that the immunological function of the thymus continues in adult dogs. The significance of the data obtained for the transplantation immunity and for understanding of the hemopoietic stem cell function, etc., is discussed. (auth)

31267 WHOLE-BODY γ-IRRADIATION, FOOD INTAKE, AND GLUCURONIC ACID EXCRETION IN RATS. Chiriboga, J. (Univ. of Puerto Rico, San Juan). Experientia, 23: 903-4(Nov. 15, 1967).

Rats were γ-irradiated with doses of 100, 400, and 1000 R. Food intake decreased severely for four days following irradiation with 1000 R. With 400 R there was a slight decrease for three days following irradiation. The decrease in food intake of irradiated rats produces a corresponding decrease in the normal total glucuronide excretion that could mask the endogenous changes caused by irradiation. In an experiment to test this possibility, eight rats were starved for three days and then irradiated with 1000 R. The excretion of total glucuronides was measured each day. The results showed increased excretion by irradiated rats compared with controls. (H.L.W.)

31268 WORKING CONDITIONS AND HEALTH OF WORKERS AT UNITED INSTITUTE OF NUCLEAR RESEARCH. Gus'kova, A. K.; Ponizovskaya, A. I.; Denisova, E. A.; Volkovickaya, V. V.; L'vovskaya, E. N.; Kotova, E. S.; Gribova, I. A. Gigiena Tr. Prof. Zabol., 10: 5-11(Jan. 1966). (In Russian).

A review is presented of the results of combined clinical and hygiene investigations for evaluation of the radiation danger, and assessment of the changes observed in various clinical indices in a group of 500 workers exposed to radiations from several sources; 220 subjects whose work did not involve contact with ionizing radiations were employed as controls. In the type of radiation hazard examined in this study, slight changes in vasoregulation proved a more sensitive indicator of the effect on man of γ and neutron radiation than the peripheral blood picture or the state of the crystalline lens. The changes detected had no appreciable adverse effects on the subjects' sense of well-being, showed little increase over the observation period, and did not affect work efficiency. (Occup. Safety and Health Abstr.)

31269 WPLYW DAWKI 2600 R PROMIENI γ NA PROCESY ENDOKRYNOWE U MOTYLA WILCZOMLECZKA (CELERIO EUPHORBIAE L.). (The Effect of a 2600 R of γ Radiation Dose on the Endocrinal Processes in the Celerio Euphorbiae L. Butterfly). Piechowska, Maria Janina. Polskie Towarzystwo Biochemiczne Monografie Biochemiczne 13. Warszawa, Panstwowe Wydawnictwo Naukowe, 1966. 79p.

The theoretical aspects and results of the experimental study of the effects of γ radiation on the biochemical processes of the butterfly Celerio euphorbiae L., are reviewed, with emphasis on the biological and physiological changes related to the metamorphic changes of these insects under various conditions of temperature and starvation. It was found that radiation caused the strongest effects in very young caterpillars, irradiated at the start of the third development period. The frequency and the duration of the metamorphic processes were found to be nonuniform. Under certain conditions, a 95% mortality was observed. Strong disturbances in the production of the juvenile hormones were noted; they affected the duration of the larval periods. The older caterpillars exhibited a strong radiation resistance; the external appearance of the image was normal for 73% of the insects irradiated at the start of the fourth period; however, the heads, legs, and wings of the caterpillars irradiated at the end of metamorphosis were strongly deformed, rendering them unable to move. The reproductive organs of both males and females were undeveloped in the irradiated population. (TTT)

31270 LOW DOSE X-IRRADIATION AND TERATOGENESIS. A Quantitative Experimental Study with Reference to Seasonal Influence on Dose Effects. Jacobsen, Lars. Copenhagen, Univ. of Copenhagen, 1968. 208p.

Thesis.

Certain well-defined and easily diagnosed congenital malformations and developmental retardations were utilised as indices of possible teratogenic effects of experimentally applied low dosage X-irradiation. Pilot studies indicated that in the mouse strain used, the relationship of radiation effects to season might be of interest. The research material and handling thereof are discussed in some detail. The control group comprised 500 mothers with 2857 young, the 5 R group 375 mothers with 2278 young; the 20 R group 100 mothers with 527 young, and the 100 R group 25 mothers with 106 young. The correlation between events of the first pregnancy and observable features of the second appeared quantitatively similar in the four experimental groups. Exposure of HC strain mice to 5 R, 20 R or 100 R on the 8th day of pregnancy results in inhibition of growth-processes in the development of the products of conception. The effects of 100 R are especially marked. Several types of anomaly, especially of ribs and sternum, showed clear response to 5 R and 20 R doses. Different summer and winter incidences exist within the same experimental group. In addition, a remarkable shift of occurrence of the most pathological incidences from summer to winter takes place with rising dose. Increase in radiation exposure is associated with pronounced rises in total incidences of malformation in all regions. The effect is most clearly discernible on examination of results within a season, and exposure to 5 R produces a significant rise in frequency in all regions and both seasons. The dose effect curves obtained for the various regions show that the radiation effect in these increases linearly with the doses administered. This indicates that no threshold dose exists for induction of the defects studied here. Therefore irradiation of the present material with doses of less than 5 R may initiate teratological precesses of a potency which may lead to increased risk of fetal damage. (Denmark)

31271 REGENERATION OF LOCALLY IRRADIATED BONE MARROW. II. INDUCTION OF REGENERATION IN PERMANENTLY APLASTIC MEDULLARY CAVITIES. Knospe, William H. (Presbyterian-St. Luke's Hospital, Chicago); Blom, Johannes; Crosby, William H. Blood, 31: 400-5(Mar. 1968).

Marrow cavities of rats, permanently aplastic after x irradiation, were mechanically disrupted and locally injected with bone marrow obtained from an opposite leg. Hemopoietic bone marrow regenerated with restoration of normal parenchymal and sinusoidal architecture. Mechanical disruption alone or intravenous transfusions of isogeneic bone marrow alone failed to induce any evidence of regeneration of the aplastic marrow. (auth)

31272 SULFHYDRYL CONTENT OF RAT ASCITES HEPATOMAS WITH DIFFERENT SENSITIVITY TO X RAYS AND NITROGEN MUSTARD N-OXIDE. Matsudaira, Hiromichi; Sekiguchi, Toyozo; Orii, Hirotake; Sekiguchi, Fumiko; Nagasawa, Hatsumi (National Cancer Center Research Inst., Tokyo). Gann, 58: 415-26(Oct. 1967).

Comparative studies were made on cellular sulfhydryl content and other biochemical properties in three strains of Yoshida ascites hepatoma of rats that were known to have different sensitivity to x rays and nitrogen mustard N-oxide. The sensitive strain (AH-130) had a longer mean generation time than the resistant strains (AH-7974 and AH-130R). Effects of x irradiation on mitosis and the mitotic cycle were greater in the sensitive than in the resistant strains. Activities of several enzymes of the sensitive strain were different from those of the resistant strains, indicating the difference in cell origin or cell population of these hepatoma strains. Alkaline phosphatase activity was remarkably high in the sensitive strain, whereas that of deCMP deaminase was not detectable in the sensitive strain but present in resistant strains. Patterns of lactic dehydrogenase isozymes on the polyacrylamide gel electropherogram in the sensitive strain were also different from those of the resistant strains. Content of nonprotein SH groups was lower in the sensitive than the resistant strains, whereas that of apparent protein SH was higher in the sensitive than the resistant strains. Activity of glutathione reductase was lower and that of glucose-6-phosphate dehydrogenase higher in the sensitive strain than in the resistant strains, indicating the difference in the regulatory mechanism of cellular sulfhydryl level in these hepatoma strains. (BBB)

31273 CHANGES IN THE ELIMINATION OF 17-KETOSTEROIDS AND 17-HYDROXYCORTICOSTEROIDS DURING RADIOTHERAPY OF FEMALE GENITAL CARCINOMA. Szereday, Zoltan; Szegvari, M. (Orvostudomanyi Egyetem, Szeged, Hungary). Arch. Geschwulstforsch., 21: 221-4(1963). (In German).

The effects of combined Ra and x-ray therapy on excretion of 17-ketosteroids and 17-hydroxycorticosteroids in 30 patients (33 to 78 yr of age) with uterine carcinomas were studied. Treatment consisted of two Ra treatments separated by a 10-day interval, followed by 40 × 200 R x irradiations of the usual four gynecological fields and a third Ra treatment. The patients (average age of 56 yr) received 6000 mg-hr of Ra and an 8000 R dose of x irradiation. Excretion of 17-ketosteroids was not markedly altered from that of normal by the treatment. As shown by comparison of data obtained over the period from two days before to two days after treatment, the excretion of 17-hydroxyketosteroids varied considerably. After the first and second Ra treatment the excretion was reduced slightly in some of the patients. The value of this reduction was not statistically significant. However, after the x irradiation and the third Ra treatment the excretion of 17-hydroxyketosteroids increased considerably above normal. Results did not permit the authors to draw any prognostic conclusions. (BBB)

31274 NEW CONCEPTIONS IN RADIOBIOLOGY AND RADIOTHERAPY. Wideroee, R. Radiol. Clin. Biol., 36: 308-22(1967).

Though many radiobiological results seem partly contradictory, some useful conclusions for radiotherapy can be drawn. The two-component theory of radiation can explain most results with different radiations and also help in understanding the oxygen enhancement ratio. In radiotherapy the parameters might vary to a much higher degree than with cell cultures, the average values, however, are similar to the results in vitro. Electivity between the normal cells in the tumor bed and the tumor cells is of utmost importance and can be increased considerably by using single doses of high-energy electrons. A treatment program based upon such principles, which in many cases has proved highly successful, is described and evaluated. (auth)

31275 RADIOISOTOPIC POWER SOURCE FOR AN ARTIFICIAL HEART. Bruner, H. D.; Burr, W. W. Jr.; Sagan, L. A. (United States Atomic Energy Commission, Washington, D. C.). Trans. Amer. Nucl. Soc., 11: 401(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31276 INVESTIGATIVE STUDIES WITH QUARTZ RODS FOR HIGH ENERGY LASER TRANSMISSION. Goldman, Leon; Hornby, Peter; Rockwell, R. James; Brown, Thomas E.; Meyer, Robert (Children's Hospital Research Foundation, Cincinnati). Med. Res. Eng., 6: 12-17(Fourth Quarter 1967).

Effects of laser radiation, transmitted through special high-quality, curved tapered quartz rods, were studied. The rods were so designed to give total internal reflection, about 90% of the beam being transmitted. These rods enabled increased flexibility of the laser for biomedical instrumentation. The rods were effectively used for studies in laser surgery, both in animals and in man. In animals, the rods were used on skin, on vascular structures including the heart, and on brain tissues. When the quartz rod was inserted into brain tissue, laser-induced tissue damage was found only at the tip of the rod. Similar studies were obtained with Nd and Ar laser systems. Numerous impacts with a pulsed ruby laser (normal mode) were performed on the skin, liver, kidneys, heart, spleen, and brain of dogs, guinea pigs, rats, and mice. Discrete lesions with diameters nearly identical to the exit tip diameter of the rod resulted and penetrated less than 1 mm at 10 J, whereas tissue penetration increased to a maximum of 1 cm in a highly vascular organ (such as brain or liver) with 40 to 60 J. The rod permitted production of a laser lesion at a precise focus in the depths of a tissue, enabling study of localization of the resultant laser destruction and the function of loci of certain nuclear complexes of neural tissue. Forty-eight lesions were produced in the diencephalon of dogs and monkeys for acute and long-term studies. In man, the rods were used on accessible cancers or cancers made accessible by surgery, on angiomas, tattoos, and warts. (BBB)

31277 TREATMENT OF CHRONIC LYMPHOCYTIC LEUKEMIA BY EXTRACORPOREAL IRRADIATION. **Storb, R.; Epstein, R. B.; Buckner, C. D.; Thomas, E. D. (Univ. of Washington, Seattle. Public Health Service Hospital, Seattle). Blood, 31: 490-502(Apr. 1968).**

Six patients with advanced chronic lymphocytic leukemia were treated with extracorporeal x irradiation and followed for one to three years. There was a marked reduction in the circulating white cells in all patients, but in four cases the white cell counts returned to high levels in 3 to 7 months. Two patients were in good partial remission 37 and 22 months after the initial course of ECI. Clinical and hematological events in these cases are detailed. It was concluded that ECI is effective in lowering leukocyte levels without systemic toxicity and is beneficial in some cases of chronic lymphocytic leukemia. (auth)

Radiation Effects on Plants

Refer also to abstracts 30954, 30974, 31014, 31017, 31020, 31022, 31024, 31031, 31043, 31044, 31052, 31053, and 31205.

31278 ACTION OF CHLORAMPHENICOL ON THE GROWTH OF THE ROOTS OF SHOOTS EXPOSED TO HIGH X-RADIATION DOSES. Ivanov, V. B. (Inst. of General and Inorganic Chemistry, Moscow). Dokl. Akad. Nauk SSSR, 173: 217-20(1967). (In Russian).

In order to establish which of the meristematic processes of root growth is involved in the synthesis of albumins required for maintaining the normal growth rate of roots, the effect of the known albumin inhibitor, chloramphenicol, on the growth rate of roots in which the reproduction of the cells was suppressed by exposure to x radiation, was investigated. The work was carried out on the Sterling Dnepropetrovskii variety of corn, exposing the plants to two and 10 kR of x radiation at a dose rate of 110 kR/sec. It was found that the growth rate decreases after irradiation. Addition of chloramphenicol did not affect the growth rate of roots exposed to doses up to 100 kR; some inhibiting action at lower total doses; in ordinary, unirradiated plants the inhibiting action was strong, increasing with increasing growth of the roots. It was concluded that the slowing down of the growth by the antibiotic in specific concentrations is due to the suppression of cell division; when the division is already suppressed by the radiation, the antibiotic does not affect the ultimate length or the rate of growth. However, care must be taken when attempting to generalize this conclusion. (TTT)

31279 RBE OF 14 MeV NEUTRONS IN BARLEY. **Cercek, Lea; Ebert, M.; Frost, Pamela; Greene, D. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Int. J. Radiat. Biol. 12: 405-13(Oct. 12, 1967).**

The effects of 14 MeV neutrons were compared with those of ^{60}Co γ-rays in barley seeds. After irradiation the seeds were germinated on wet filter paper and the lengths of the first leaf and coleoptiles were measured. The results for leaf growth were fitted to an exponential function down to 20% decrease for both types of irradiation. The mean RBE was found to be 11.0 ± 1.4. Coleoptile growth showed initially an exponential response to γ and neutron irradiation. The exponential parts gave a mean RBE of 5.1 ± 0.36. Both RBE values (11.0 and 5.1) were calculated from the doses stated as Rads in water at the position of the seeds. When the elemental composition of the barley plant was taken into account the RBE values became 14.5 for leaf growth and 6.6 for coleoptile growth. (auth)

31280 ABILITY OF SYNCHRONIZED UNICELLULAR VOLVOCALES TO DIVIDE AFTER X IRRADIATION. **Berger, M. (Kernforschungsanlage, Juelich, Ger.). Int. J. Radiat. Biol., 12: 477-86(Oct. 12, 1967). (In German).**

The ability of synchronized unicellular algae to divide after x irradiation was studied by comparing the production of cells (division factor) after 2 to 3 nuclear divisions. With a photoperiod of seven hours light and 17 hours darkness and daily renewal of the medium, the cells of all species divided, i.e., autospores were liberated, as soon as the light period started. In Haematococcus the increase in the radioresistance found in the light period was preceded by an increase during the last hours of the dark period. This increase continued in a prolonged dark period. The increase was at least partially independent of DNA synthesis. Comparison of the x-radiosensitivity of different species (Haematococcus pluvialis, Chlamydomonas chlamydogama, C. moewusii, C. eugametos, and C. reinhardi) revealed no correlation with the DNA content. A correlation, however, between the x-radiosensitivity and the division factors of the species was demonstrated. (auth)

31281 CHANGES OF CHEMICAL COMPOSITION IN PLANTS DURING IRRADIATION AT VARIOUS PERIODS OF ONTOGENESIS IN RELATION TO CLIMATIC FACTORS. **Zhunusov, R. S. Izv. Akad. Nauk Kazakh. SSR, Ser. Biol. Nauk, No. 1, 65-9(1965). (In Russian).**

A three-yr research program indicated that some cereals, beans, and edible bulb and root plants improved in chemical composition as a result of small doses of γ irradiation when it was applied at a specific time, and if the conditions, such as temperature, amount of precipitation, and humidity, were favorable. The nature of the plants' reaction to irradiation was reflected by their metabolic state at the time of exposure. To increase the protein content by 2%, it was advantageous to conduct irradiation at the time of plants' budding (beans, 2% increase) or at the formation stage of fruiting spikes (cereals, by 8%). An increase of the content of starch in potatoes was attained by irradiation during the formation of the underground tubers. The weight increase of edible roots and the enhancement of the sugar content in sugar beets by 7% required that irradiation be applied at an early stage of the accumulation of sugar; this also increased the degree of sweetness in rootlike stems. As expected, growth conditions were of importance, since they determined the nature of the metabolic processes in plants, while the irradiation merely intensified the rate of the processes. Irradiation produced negative effects in development of some plants if the basic principles of plant cultivation were disregarded. (BBB)

31282 EFFECTS OF IONIZING RADIATIONS ON SEX TYPES AND EXPRESSION ON MOMORDICA CHARANTIA L. AND CUCUMIS SATIVUS L. **Generoso, Walderico M.; Campos, Filomena F. (Univ. of the Philippines, Manila). Philippine Agr., 49: 52-7 (June 1965).**

In Curvrbitaceae, almost all types of sex expression were represented, ranging from dioecious to hermaphroditic forms. In Momordica and Cucumis, monoecism was the typical condition and generally the frequency of staminate to pistillate flowers was higher. A study was conducted to determine whether sex types and sex ratio could possibly be altered by treatment with varying doses of x and γ rays. Dry dormant seeds were exposed to x rays or a ^{60}Co source at doses of 1, 2.5, 5, 10, 15, 25, 35, and 50 kR. In Momordica there was an increase in the proportion of staminate to pistillate flowers in the x-ray series but none in the ^{60}Co series. On the other hand, sex ratio in Cucumis was not altered by irradiation although reductions in the number of staminate and pistillate flowers were noted. Sex reversion was observed only in Momordica plants on the treated and its subsequent generation. Two types of sex-reversed flower were found. In one type, dissection of the flower revealed a slightly developed pistil. Sections of the ovary, however, showed no ovules, hence these flowers did not set nor did fruits develop. Dehiscence of these flowers occurred very much later than in the normal samples. The frequency of this type of flower was 0.38% from all the lots of the x-rayed population and 0.53% from the γ-ray-treated lots. Another type of sex-reversed flowers was found among Momordica plants in the 50-kR group of the X_1 and X_2 generations. These plants bore perfect flowers together with staminate and pistillate flowers at a frequency of 2.2%. The results showed that, in general, sex types in Cucumis were not affected by the kind and dose levels of radiation. Cucumis was inherently more genetically stable as regards sex-determining factors than Momordica. (BBB)

31283 EFFECT OF CHLORAMPHENICOL ON ROOT GROWTH OF SEEDLINGS IRRADIATED WITH HIGH X-RAY DOSES. **Ivanov, V. B. Dokl. - Bot. Sci. Sect. (Engl. Transl.), 172: 29-32(Apr. 1967).**

Corn seedlings were irradiated with 70-KV x rays at doses up to 70 KR and in some instances also treated with chloramphenicol. After irradiation with doses of 6.25 KR and higher, root growth ceased in three days and all meristematic cells lengthened and differentiated. Lateral roots did not appear. The lower the radiation dose, the greater was the increment of the roots up to the cessation of growth. Length of the cortex cells differed little throughout the increment, and, up to a dose of 100 KR, was similar in control and irradiated roots. Calculations showed that cell division stopped almost completely at doses of 50 to 100 R and higher. This was confirmed by Feulgen-stained longitudinal root sections. Mitoses were absent in the roots of irradiated (100 KR) seedlings after 16, 24, 48, and 72 hr. Effect of chloramphenicol (50 μg/ml) on the length of maximal increment and on growth rate of irradiated roots was examined. Results showed that the effect of chloramphenicol on length of maximal increment decreased with suppression of cell formation by irradiation. After irradiation, the growth rate of the roots dropped steadily. Chloramphenicol did not affect the rate in roots of seedlings irradiated with doses of 50 to 100 KR. Growth retardation by chloramphenicol in low concentrations was associated with suppression of cell division. When division was inhibited, chloramphenicol did not affect either growth rate or size of the maximal increment. Hydrazide of maleic acid (HMA) at a concentration of 100 μg/ml also failed to inhibit root growth of seedlings irradiated with doses of 25 to 100 KR. On treatment of roots, that were irradiated with a dose of 100 KR, with colchicine (100 μg/ml), 6-benzylaminopurine, and α-naphthylacetic acid (100 μg/ml), swellings formed that were externally indistinguishable from those that formed on normal roots. Chloramphenicol inhibited development of swellings brought about by these substances in control roots. In irradiated roots (100 KR) treated with chloramphenicol (250 μg/ml), given in conjunction with colchicine, growth of the swellings was suppressed to the same degree as in normal roots. The results indicated that weakening of the effect of chloramphenicol (50 μg/ml) on growth of irradiated roots was associated with their lack of cell division and was not connected with some general, nonspecific cause (e.g., change in permeability). The possibility of using irradiated roots as a model for a study of cell growth by elongation was suggested. (BBB)

31284 EFFECTS OF GROWTH INHIBITORS AND X RAYS ON THE GROWTH OF PEA ROOTS. **Brucker, W. (Univ., Griefswald, Ger.). Wiss. Z. Ernst-Moritz-Arndt-Univ. Griefswald, Math.-Naturwiss. Reihe, 15: 41-52(1966). (In German).**

Root growth in *Pisum sativum* was studied after x irradiation given to germinated seedlings 3 days after treatment with Mitomen, triethylenethiophosphoramide (thio-TEPA), triethylenemelamine (TEM) 2,3,5-triethyleneimino-1,4-benzoquinone (Trenimon), or 1-ethyleneimino-2-hydroxybutene-3 (Tetramin) at concentrations of 5×10^{-5} and 10^{-4} g/ml. Thio-TEPA, Trenimon, and Tetramin plus a dose of 100 R enhanced the radiogenic growth depression by 400%. Under the same conditions TEM reduced the irradiation growth effect caused by a 100 R dose. None of the cytostatics tested had any effect when 400 R was given. Pretreatment with mitomycin C reduced the irradiation effects of 400 R. Combined treatment with mitomycin C and 100 R increased growth. Actinomycin ^{3}C and aureomycin acted similarly. Sarcomycin A and chloramphenicol increased the radiogenic growth depression caused by 100 R. However, when 400 R was given, these two compounds produced a considerable protective effect against the irradiation. Pretreatment with aminopterin and deoxypyridoxine increased the radiogenic effects of 100 R more than the sum of their single effects. The growth depression produced by 400 R was not affected by either antivitamin. Triiodothyronine and vitamin K increased root growth. At a concentration of 5×10^{-5} g/ml, triiodothyronine protected the plants against effects of 100 R of irradiation, but it was ineffective at 400 R. Vitamin K_1 at the same concentration increased the effects of 100 R by a factor of 2, and had a slight effect at 400 R. No effects on growth were shown by β-indolylbutyric acid and kinetin at either 100 or 400 R. References cited, 97. (BBB)

31285 EFFECTS OF X- AND GAMMA RADIATION ON ANTHOCYANIN CONTENT IN LEAVES OF RUMEX AND OTHER PLANT GENERA. **Sparrow, A. H.; Furuya, M.; Schwemmer, Susan S. (Brookhaven National Lab., Upton, N. Y.). Radiat. Bot., 8: 7-16(Feb. 1968). (BNL-11705).**

The concentration of anthocyanin pigments in the leaves of seedlings of *Rumex crispus* L., *R. hydrolapathum* Huds. and *R. sanguineus* L. was found to increase following exposure to x rays or ^{60}Co γ rays. The time-course of formation of and the increase in extractable anthocyanins were dependent upon the species, the exposure, and the age of the leaves at the time of irradiation. Maximum increased content approached 20-fold that of untreated plants. Large increases in anthocyanin content after irradiation were generally indicative of lethal or near lethal exposures. Chromatographic studies of the anthocyanin offered no evidence of a radiation-induced change in the structural integrity of the pigment molecules. A visual increase in red pigmentation occurred in the leaves of 16 species from other genera irradiated chronically, and 21 species irradiated acutely. It thus appears that enhanced pigment (presumably anthocyanin) formation is a common response of higher plants to ionizing radiation. The exposure required to produce significant increases varied widely with the species. (auth) (UK)

31286 PHOTOREACTIVATION IN CHLAMYDOMONAS REINHARDI DANGEARD. **Ryznar, L.; Drasil, V. (Inst. of Biophysics, Brno). Folia Microbiol. (Prague), 12: 524-8(1967).**

The experiments described verified the existence of photoreactivation after uv irradiation of the unicellular alga *C. reinhardi*. Whether it was photoreactivation in the normal meaning of the term, and not some other repair process, was investigated by irradiating some of the alga with x rays, as it was known that lesions caused by ionizing radiation could not be photoreactivated. Cells irradiated with uv light and immediately exposed to photoreactivating light for five hr had a much higher survival rate than irradiated cells left for six hr in the dark. Conclusive quantitative evaluation of the results was made by determining the dose-reducing factor (DRF), which was constant throughout practically the whole of the dose range and was about 0.5. The lesion formed by x irradiation of the cells was not susceptible to photoreactivation. The course of the curves for survival in the light and dark was the same. About 30-min exposure to photoreactivating light of 2300 Lx was needed to achieve the maximum photoreactivation, clearly indicative of the presence of some factor limiting the rate of the increase in the survival rate. No difference was found in the course of this relation when photoreactivation was started 30 min after uv irradiation. The degree of photoreactivation was higher with high intensities and short exposures than with long exposures and low intensities, i.e., the photoreactivation effect was greater in the first case even though the total incidence of light energy was the same in both instances. (BBB)

31287 PRELIMINARY INVESTIGATIONS ON THERMOLUMINESCENCE AND RADIOSENSITIVITY IN SEEDS. **Cervigni, T.; Caserta, G.; Bassanelli, C. (CNEN, Rome). Radiat. Bot., 8: 71-9(Feb. 1968).**

Thermoluminescence measurements on plant seeds of different radiosensitivity were performed in order to find a relationship between glow curves and mean lethal radiation exposure (LD_{50}). Lyophilized powders, obtained from seeds of eleven species and varieties of angiosperms, were irradiated at 77°K with 250 kVp, 15 mA x-rays. The samples received a total exposure of 20 kR under a vacuum of less than 10^{-3} mm Hg. After irradiation the glow curves were recorded and glow curve areas measured. A relationship was found between glow curve areas and LD_{50} which was approximately expressed as $A = a\,(LD_{50})^{n}$. A series of extractions of seed components for three species very different in LD_{50} values were performed in order to separate the components responsible for the correlation. It was found that the lipidic components were correlated with the LD_{50}'s nearly as well as the whole seeds. (auth) (UK)

31288 RADIATION STUDIES OF BLASTOCLADIELLA EMERSONII. **Deering, R. A. (Pennsylvania State Univ., University Park). Radiat. Res., 34: 87-109(1968).**

Populations of *Blastocladiella emersonii* zoospores undergo synchronous germination, nuclear division, and development. Three characteristic responses noted for ultraviolet- or gamma-irradiated zoospores, namely: development to a normal, surviving sporangium of about 60 microns in diameter with emission of zoospores and colony formation; a giant sporangium of about 200 microns in diameter, sometimes giving off zoospores after a lag; and a slower growing germling with the usual rhizoids, followed by an abrupt cessation of growth at a diameter of about 30 microns, with no zoospore emission were observed. This block indicated in the latter occurred at about the same point with either uv or gamma rays over a considerable range of dose. During the earlier growth of this blocked germling, nuclear division did not occur normally. The uv damage was photoreactivable. Survival of colony-forming ability was determined for germlings irradiated at various stages of their nuclear division up to the four nucleus stage. They were the most sensitive just after nuclear division and most resistant just before. Of several hypotheses to explain this variation, differential repair of damage seemed to be the most plausible. (auth)

31289 THE DEPENDENCE OF THE BIOLOGICAL EFFECT OF IRRADIATION ON THE PHYSIOLOGICAL CONDITION OF THE SEEDS OF TRITICUM DURUM VAR. AEGYPTIACUM. **Belichenko, N. I.; Nguyen Hyu-Ngya (Univ. of Rostov-on-Don, USSR). Genetika, 4: No. 3, 175-7(Mar. 1968). (In Russian).**

X rays and γ rays affected considerably the nuclear apparatus of Triticum durum var. aegyptiacum. When germinating seeds were irradiated, the effects of x rays and γ rays were approximately equal, while the effect of γ rays on dry seeds was about twice as drastic as that of x rays. The storage of irradiated seeds during 113 days at 20 to 22°C resulted in a considerable (more than two-fold) increase of the biological effects of irradiation. (auth)

31290 CYTOPHYSIOLOGICAL AND BIOCHEMICAL INVESTIGATIONS OF YEAST-LIKE MICROORGANISMS DURING THEIR RECOVERY AFTER RADIATION INJURY. **Meisel', M. N.; Remezova, T. S.; Biryuzova, V. I.; (and others) (Inst. of Microbiology, Moscow). Izv. Akad. Nauk SSSR, Ser. Biol., 6: 827-51(Nov.-Dec. 1964). (In Russian).**

Postradiation recovery of different yeast species was studied by two to three days incubation of irradiated (dose of 50 to 150 KR) yeast cells in sterile water followed by cultivation in malt-agar medium. Cytological studies (phase contrast, fixed and stained preparations, fluorescent and electron microscopy) showed that incubation in water led to rapid utilization of reserve metabolites. On cultivation in malt-agar medium the hypertrophy of nuclei and inhibition of their division were observed. Hyperplasia of endoplasmic reticulum and division of mitochondria during cell restoration were detected by electron microscopy. Physiologically, the cells which were incubated in water were characterized by a distinct level of endogenous respiration; the respiration of irradiated and recovering cells was 30 to 50% more intensive than that of nonirradiated ones. A close correlation between endogenous respiration and recovery was observed. The respiratory enzymes and the cytochrome system were important for successful postradiation restoration. Yeast cells with defective cytochrome systems did not recover. Restoration did not take place in anaerobic conditions (without exogenous carbohydrates). Under these conditions the irradiated cells could be kept up to 15 days, and even after this time were capable of complete restoration upon being transferred to aerobic conditions. Thus, the energy obtained by the cell by endogenous respiration was necessary for postradiation recovery. In cells during postradiation recovery, notable shifts in the content of nitrogen, carbohydrate, phosphorus (nucleic acids), and lipid compounds were detected. Therefore, besides energetic processes, the synthesis of new molecules (amino acids, nucleotides, and other precursors) to a limited extent also took place in recovering cells. The postradiation recovery of yeast cells was greatly influenced by their radioresistance, dependent to some extent on the stability of nucleoprotein complexes and by the conditions of cultivation before irradiation (aeration; content of proteins, lipids, reserve substances; avitaminosis; starvation). (BBB)

Radiation Effects on Microorganisms

Refer also to abstracts 30942, 30952, 30953, 30971, 31000, 31033, 31040, 31042, 31046, and 31172.

31291 (AD-663360) RESULTS OF INVESTIGATION OF THE EFFECT OF COSMIC RADIATION AND OTHER FACTORS OF COSMIC FLIGHT ON LYSOGENIC BACTERIA AND HUMAN CELL CULTURES. Zhukov-Verezhnikov, N. N.; Mayskii, I. N.; Pekhov, A. P.; Rybakov, N. I.; Dobrov, N. N.; Antipov, V. V.; Kozlov, V. A.; Saksonov, P. P.; Podoplelov, I. I. Translated from Izv. Akad. Nauk SSSR, Ser. Biol., No. 4, 592-3(1966). 8p. (FTD-HT-67-200). CFSTI.

Single-layer cultures of normal human cells (fibroblasts and amniotic cells) and human cancer cells (Hela strain), together with cultures of lysogenic bacteria (Escherichia coli K-12), were consistently used as radiation indicators on Soviet spacecraft. Results of these experiments showed that repeated exposure of a culture of Hela cells to spaceflight factors on the Vostok-4 and Vostok-6 flights produced changes in experimental cells as compared with laboratory controls and with Hela cells exposed on one spaceflight only. A longer latent period of recovery of growth capacity and other characteristics were noted in twice-flown cultures. In addition, the coefficient of proliferation for Hela cells exposed on both Vostok-4 and Vostok-6 was one-half that for intact controls and for Hela cells exposed to spaceflight only once. These data suggest a direct dependence of the biological effect on spaceflight factors. The effect of the length of spaceflight exposure has not been established in experiments with the lysogenic bacteria, Escherichia coli K-12 (λ). It is interesting to note that when the same Hela cells used on Vostok-4 and Vostok-6 were also exposed on Vostok-1, a well-defined drop in the proliferation coefficient was observed in comparison with intact cultures. Other reliable differences were also found between intact controls and thrice-exposed cultures. However, no reliable differences could be detected between thrice-exposed Hela cells and a control strain used only on Vostok-6. It is suggested that the biological effect of spaceflight may be the result of the combined influence of radiation, vibration, and weightlessness. (auth)

31292 REPAIR-INDUCED CHANGES IN YEAST RADIOSENSITIVITY. **Patrick, M. H.; Haynes, R. H. (Southwest Center for Advanced Studies, Dallas. Univ. of California, Berkeley). J. Bacteriol., 95: 1350-4(Apr. 1968).**

Potentially lethal x ray or uv damage in the diploid yeast, Saccharomyces cerevisiae, can be reversed if the irradiated cells are incubated in distilled water or buffer for a number of hours prior to plating. This phenomenon is called liquid-holding recovery. We found that the liquid-holding procedure served not only to restore the viability of the irradiated cells, but also to alter their sensitivity to further doses of radiation. Specifically, the ultraviolet sensitivity of cells which had undergone liquid-holding recovery was markedly decreased, whereas their x ray sensitivity appeared to be slightly increased. These sensitivity changes were qualitatively the same irrespective of whether the initial radiation exposure was to x rays or ultraviolet light. In contrast, the radiation sensitivity of cells which had undergone maximal photoreactivation was essentially the same as that of untreated controls. It is suggested that these changes in radiosensitivity are the result of structural alterations induced in the cell's deoxyribonucleic acid by the execution of at least the initial steps of a deoxyribonucleic acid repair process during the liquid-holding period. (auth)

31293 CsCl DENSITY GRADIENT CENTRIFUGATION STUDIES OF INTACT BACTERIAL CELLS. **Pollard, Ernest C.; Grady, Leo J. (Pennsylvania State Univ., University Park). Biophys. J., 7: 205-13(Mar. 1967).**

Effects of γ irradiation on sedimentation rates of cells of Escherichia coli were examined. In preliminary studies the nonirradiated cells were successfully banded in CsCl density gradients and a portion of the population reclaimed in a viable state. Differentiation between two strains of E. coli in a CsCl density gradient was also demonstrated. Studies were undertaken to see whether differences could be detected between two samples of cells of the same strain which had been subjected to different conditions. Introduction of a heavy label (5-bromouracil) into the DNA during a 90-min period did not produce an observable change in cell density. Removal of a required amino acid from the growth medium of an E. coli auxotroph resulted in an increase in both the density and heterogeneity of the cells. To observe the effect of ionizing radiation on the banding pattern, the auxotroph was grown in the presence of thymine-^{14}C, then resuspended in fresh isotope-free medium and exposed to 27 kR of γ radiation, from a ^{60}Co source. After a 2 hr incubation at 37°C, the irradiated suspension was mixed with a ^{32}P-labeled control culture and samples centrifuged. Irradiation was followed by a period during which portions of both DNA and RNA were lost, giving two distinct bands, one at the normal position in the gradient and the other shifted to a lighter region. (BBB)

31294 CORRELATION OF ALTERATION IN CHROMOSOME REPLICATION SEQUENCE WITH CELL LETHALITY. **Achey, P. M.; Billen, D. (Anderson Hospital and Tumor Inst., Houston, Tex. Univ. of Florida, Gainesville). Radiat. Res., 33: 533-9 (1968).**

A comparison of two methods of analyzing DNA replication in bacteria was made. Oxygen sensitization of DNA replication to x irradiation was studied by analysis of the replication sequence (qualitative measurement) and assay of the amount of incorporation of radioactive precursor into the DNA fraction (quantitative analysis). An alteration in the sequential replication of the bacterial chromosome was observed within ten minutes of postirradiation incubation at colony survival of 65 to 75%. A 7500-R dose of x rays with nitrogen bubbling induced the same extent of alteration in replication sequence as a 2000-R dose with oxygen bubbling, resulting in a dose-reduction factor of 3.75. As a result of radiation doses allowing 70% survival, a clear and immediate alteration of the replication sequence was evident. In contrast, only a slight delayed effect on DNA synthesis was reflected when the rate of radioactive thymine uptake was measured. These results indicate that analysis of sequential DNA replication is a relatively sensitive and reliable index of lethal chromosome injury, which is correlated with lethal cell injury. (auth)

31295 CYBERNETIC STUDIES ON THE RADIATION EFFECT ON YEAST CELLS. III. INFLUENCE OF FINITE LIFETIME AND SYSTEMATIC VARIATIONS OF THE CYCLE TIME ON THE CELL REPRODUCTION. **Pohlit, W. (Max-Planck-Institut fuer Biophysik, Frankfurt am Main). Biophysik, 4: 30-7(1967). (In German).**

It was shown that in the case of various cycle lengths for mother and daughter cells after one cell generation an exponential increase of the population occurs whose doubling time is much longer than the cycle length of the mother cell and must be considered in the experiment. The effect of the life span of the cells is therefore negligibly low in yeast cells. The measured doubling time is identical with the cycle length of the cells. (tr-auth)

31296 EFFECT OF ULTRAVIOLET IRRADIATION ON THE ACID-FASTNESS OF DIFFICULT TO CULTURE AND UNCULTURABLE MYCOBACTERIA. **Murohashi, Toyoho; Yoshida, Konosuke (National Inst. of Health, Tokyo). Amer. Rev. Respirat. Dis., 97: 306-10(Feb. 1968).**

The effect of uv irradiation on the acid-fastness of difficult to culture mycobacteria, M. paratuberculosis, and unculturable mycobacteria, M. leprae and M. lepraemurium was investigated. Results showed that M. paratuberculosis was stronger in acid-fastness than M. tuberculosis, and that M. leprae and M. lepraemurium were much stronger. Ultraviolet irradiation time required for 50% loss in acid-fastness for M. leprae and M. lepraemurium was about twice that for M. tuberculosis. An acid-fastness map was designed to sum up the results hitherto obtained, and a simple, practical method to differentiate some strains of mycobacteria from others by the acid-fast staining of smears was devised and presented in tabular form. The table showed that saprophytic mycobacteria were differentiated from other types by the use of a decolorizer, 0.1% nitric acid and 70% ethanol, for 20 min. Ultraviolet irradiation preceding decoloration was used to differentiate other strains from each other: Battey-type strains were differentiated from M. avium by three-hr uv irradiation, avirulent or attenuated strains of M. tuberculosis from virulent ones by six- to seven-hr, and the latter from M. leprae and M. lepraemurium by 15-hr uv irradiation. (BBB)

31297 EFFECT OF ULTRAVIOLET IRRADIATION ON THE ACID-FASTNESS OF DRUG-RESISTANT MUTANTS OF TUBERCLE BACILLI, WITH SPECIAL REFERENCE TO THE VIRULENCE OF ISONIAZID-RESISTANT STRAINS. **Murohashi, Toyoho; Yoshida, Konosuke (National Inst. of Health, Tokyo). Amer. Rev. Respirat. Dis., 97: 283-91(Feb. 1968).**

The relation between the uv irradiation effect on the acid-fastness and the virulence for guinea pigs of mutants of tubercle bacilli resistant to major antituberculous drugs, especially to isoniazid was studied. It was found that among the mutants of tubercle bacilli resistant to major antituberculous drugs, strains resistant to more than 1 μg of isoniazid per ml of medium showed the same pattern as avirulent or attenuated strains in the uv irradiation effect on acid-fastness. This phenomenon correlated well with the pronounced attenuation of virulence for guinea pigs when the organisms were inoculated subcutaneously. The mechanism of isoniazid resistance of tubercle bacilli was discussed from the standpoint of cell wall structure. (BBB)

31298 PROPHAGE INDUCTION AND FILAMENT FORMATION IN A MUTANT STRAIN OF ESCHERICHIA COLI. **Kirby, Edward P.; Jacob, Francois; Goldthwait, David A. (Western Reserve Univ., Cleveland. Institut Pasteur, Paris). Proc. Nat. Acad. Sci. U. S., 58: 1903-10(Nov. 1967).**

A mutant of E. coli K-12 (λ), T-44 (λ), carries a mutation in the host cell that results in the induction of λ (or other inducible prophages) when grown in nutrient broth at 40°, although growth is normal at room temperature. In a defined medium this thermal induction can be prevented by hadacidin, guanosine and cytidine, or pantoyl lactone. Adenine promotes induction and reverses this protection. If the strain is cured of its prophage it forms filaments at elevated temperatures. Conditions that promote prophage induction in the lysogenic strain promote filament formation in the cured strain. Spontaneous revertants of T-44 (λ) no longer sensitive to incubation at 40° are found to be mainly of two types. One of these is similar to the wild-type except for its sensitivity to uv irradiation, while the other has a compensating mutation that prevents prophage induction, and at the same time inhibits filament formation, recombination, and repair of uv damage. (auth)

31299 RESCUE OF THE DEFECTIVE MURINE SARCOMA VIRUS GENOME BY RADIATION-INDUCED LEUKEMIA VIRUS FROM C57BL MICE. **Igel, Howard (National Cancer Inst., Bethesda, Md.); Huebner, Robert J.; Deppa, Bruce; Bumgarner, Sandra. Proc. Nat. Acad. Sci. U. S., 58: 1870-7(Nov. 1967).**

Unlike most mouse leukemia viruses, radiation-induced leukemia virus from C57Bl mice has not been shown to replicate in vitro. Mixed cell cultures of mouse embryo fibroblasts and hamster tumor cells containing the defective (noninfectious) murine sarcoma virus genome were inoculated with extracts of radiation-induced leukemic tissues and the cells were subsequently transplanted into newborn C57Bl mice. The resultant transplantable tumors yielded infectious, sarcomagenic murine sarcoma virus that could be quantitated in vitro. This virus exhibited the host range of pathogenicity and immunologic reactivity of C57Bl radiation-induced leukemia virus, indicating the sarcoma genome carried the envelope of the leukemia virus. (auth)

31300 ACTIVATION OF SPORES OF BACILLUS CEREUS BY γ RADIATION. **Gould, G. W.; Ordal, Z. J. (Unilever Research Lab., Bedford, Eng.). J. Gen. Microbiol., 50: 77-84(Jan. 1968).**

B. cereus spores (strain PX) that were exposed to 0.02, 0.06, 0.18, 0.54, and 1.08 Mrad of γ radiation became progressively more activated, i.e., they germinated more rapidly in the presence of germinants (e.g., L-alanine, inosine, n-dodecylamine, Ca dipicolinate) than did unirradiated spores. Heat- and radiation-activation differed in that irradiated spores, but not heated spores, germinated faster than untreated control spores in n-dodecylamine. The two methods of activation were similar in that both sorts of activated spores could be deactivated, and heated and irradiated spores both had increased contents of titratable thiol groups as compared with untreated spores. Germination-like changes still occurred rapidly in spores which had been subjected to doses of γ radiation sufficient to render them nonviable. Ionizing radiation, heat, and other agents which activate spores probably did so by changing the tertiary structure of spore macromolecules and thereby exposing previously masked reactive sites which were important in germination. (BBB)

Radiosterilization and Radiopreservation

Refer also to abstract 30792.

31301 RADIATION STERILIZATION OF FOODSTUFFS AND ITS EVALUATION ACCORDING TO THE FOODS ACT. **Worseck, M. (Veterinaeruntersuchungs- und Tiergesundheitsamt, Potsdam). Monatsh. Veterinaermed., 21: 366-9(May 15, 1966). (In German).**

Progress made in radiation sterilization of certain foodstuffs is discussed and a comparison of its efficiency and economic value to other methods of food preservation, such as refrigeration or canning is made. Sprouting of potatoes could be inhibited by an absorbed dose of 5000 to 10,000 R. Insect pests in grain and trichina in pork meat could be killed by 30,000 R. Surface sterilization of fruit, vegetables, fodder, or meat, or destruction of salmonella in frozen meat products required 2.5 × 10^6 R. Enzyme activation by heat, irradiation at low temperatures or in vacuo, and addition of antibiotics could reduce organoleptic changes produced during irradiation preservation. The essential health problems associated with full use of irradiation preservation were induced radioactivity by neutrons or extremely energetic electrons of ~12 MeV, which could be avoided if 5-MeV electrons were used, infestation with radioresistant bacteria, toxicity or cancerogenicity of irradiated products, and loss of nutritional value and vitamins. Viable micrococci were detected in foodstuffs even after irradiation with a dose of 6 × 10^6 R, which was three times the usual sterilization dose. It was concluded that even though the technological problems could be overcome and legal requirements met, economic feasibility of irradiation sterilization was still a major problem. (BBB)

31302 RADIATION PRESERVATION OF SEAFOOD. **Weiss, Francis J. (Library of Congress, Washington, D. C.). Trans. Amer. Nucl. Soc., 11: 86-7(June 1968).**

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31303 IRRADIATION WITH ^{60}Co (GAMMA RAYS) OF HARD WHEAT FLOUR TO DESTROY FUNGAL SPORES AND TOXINS. **Killebrew, Rosamond; Bonner, F. L.; Broce, D.; Grodner, R. M. (Louisiana State Univ., Baton Rouge). Trans. Amer. Nucl. Soc., 11: 85-6(June 1968).**

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31304 FOOD IRRADIATION: R AND D CONTINUES. **Varner, David M. Food Eng. (Philadelphia), 39: 93-4(Nov. 1967).**

Diversified food irradiation research and pilot scale operations in Austria, Belgium, Canada, Denmark, France, Germany, Japan, Netherlands, United Kingdom, and United States are briefly discussed. The influence of the Food and Drug Administration on these programs is discussed. Biochemical analyses and radiation doses that are used to determine the effects of radiation on the shelf life, storage requirements, insect pests, and bacterial and yeast contaminants of cereals, cereal products, fruits, fruit juices, vegetables, fresh and packaged meats, and soft drinks are mentioned. (B.S.L.)

31305 SUCCESSES AGAINST INSECTS AND PARASITES. **Int. At. Energy Agency Bull., 9: No. 5, 26-8(Oct. 1967).**

The procedures used in eradication of the Mediterranean fruit fly (*Ceratitis capitata*) from Central America and Capri by the sterile male technique are briefly described and discussed. The application of similar methods to combat other major insect pests are briefly mentioned. The coordinated program for the use of nuclear techniques to study and control diseases caused by internal parasites (liver flukes, hookworms, tapeworms, lungworms, and trypanosomes) is succinctly discussed in relation to vaccine production, immunology, and pathology. (B.S.L.)

31306 PRESERVATION BY IONIZING RADIATIONS. Diehl, J. F. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Z. Ehrnaehrungswiss., Suppl. 6, 32-4(1967). (In German).

The health problem represented by the consumption of irradiated foodstuffs are discussed. To support the belief that irradiated foods are healthful, experimental studies with over 15,000 mice and 10,000 rats, from which 900,000 tissue sections were studied for evidence of pathological changes are quoted. None was studied for evidence of pathological changes. No indication of injuries were found in any of the animals fed for several generations with irradiated foods. Numerous human volunteers did not suffer injuries from ingesting irradiated foods, and found them entirely palatable. Although the belief that irradiated food may become radioactive is widespread, it is unfounded. The caloric and protein qualities of foods are unchanged by irradiation. Some loss of vitamins may be observed after irradiation, but this also occurs after foods are heated. Irradiation conservation of food is relatively specialized, and does not compete directly with other ways of preserving foods. Heat-sensitive foods could be preserved by irradiation, and thus salmonella infections could be easily prevented. Insect infestation of grains could be reduced very considerably by adequate irradiation sterilization treatment, and in this way as much as 20% of entire grain shipments could be saved for human consumption. (BBB)

31307 BACTERICIDAL EFFICIENCY OF GAMMA IRRADIATION OF WATER FOLLOWING WASHING OF GRAIN. Sergeeva, S. G.; Teshitel', O. V.; Chmyr', A. D. (Odessa Technological Inst.). Izv. Vyssh. Ucheb. Zaved., Pishch. Tekhnol., No. 1, 71-3(1967). (In Russian).

Water treated with a chemical agent following the washing of grain is generally unsafe for drinking. In the present study, five experimental series were conducted to determine the bactericidal efficiency of gamma irradiation of water from grain washers. In the 1st series, the water was gamma irradiated directly as it left the grain washer; the the 2nd and 3rd series, the water was gamma irradiated following filtration through a sieve with and without ultrasound action; and, in the 4th and 5th series, the water was treated with bentonite and with bentonite combined with polyacryamide (PAA) before γ-irradiation. In all the series the water samples contained 9.5×10^6 to 2×10^7 bacteria/ml and a coli titer of 4×10^{-5}, and were γ-irradiated (^{60}Co–GUB–800 unit, 600 R/min) with doses of 83 to 12,450 joules/kg. Bactericidal efficiency indices were based on bacteria count, coli titer and titer increase. Findings show that γ-irradiation of water from grain washers sharply reduces the number of microorganisms. Bactericidal efficiency of γ-irradiation is significantly enhanced when the water is first treated with ultrasound, bentonite or PAA. Gamma irradiation without the use of a chemical agent or ultrasound does not ensure complete sterilization of water. (auth)

31308 EFFECTS OF GAMMA IRRADIATION ON CRUSHED CANNED PINEAPPLE. Sole, P.; Aguirre, F.; Rolz, C. (San Carlos National Univ., Guatemala). Int. J. Appl. Radiat. Isotop., 19: 69-74(Jan. 1968).

The effect of γ irradiation on canned raw crushed pineapple was evaluated. The bacterial population, carbohydrate and ascorbic acid contents, pH, and internal pressure were evaluated as function of irradiation dose, storage temperature, and storage time. Irradiation and storage at low temperature of crushed pineapple packed in enameled cans produced less off-flavor and straw color than at ambient temperature. As the irradiation dose was raised, acceptability of the samples decreased rapidly at first and then tended to stabilize at higher doses at a low unacceptable level. It was not possible to correlate significantly the effect of the dose and other variables on the total carbohydrate content. The ascorbic acid content was found to decrease as irradiation dose, storage time, and storage temperature were raised. (auth)

31309 RADIATION PRESERVATION. Adamiker, D. (Reaktorenzentrums, Seibersdorf, Austria). Wien. Tieraerztl. Monatsschr., 54: 267-73(1967). (In German).

The reasons for the interest in radiation preservation of foods and drugs are briefly outlined. The minimum lethal radiation doses for various bacteria and fungi are tabulated. The research done to determine the toxicity of irradiated foods is discussed. A typical irradiation installation that employs a ^{60}Co γ source techniques for its use are briefly described. (J.S.R.)

31310 RADIOSTERILIZATION OF MEDICAL PRODUCTS. Gerrard, Martha. Isotop. Radiat. Technol., 5: 303-5(Summer 1968).

The proceedings of the 1967 IAEA-sponsored Budapest symposium on the use of radiation to sterilize pharmaceuticals, biological tissues, instruments, and prosthetic devices and to prepare vaccines are reviewed. Radiation sensitivity of and testing for microorganisms, economics of radiation sterilization, and final recommendations for an international code of practice are also covered. (auth)

31311 TOUR OF THE PORTABLE CESIUM IRRADIATOR. McKinney, F. E. Isotop. Radiat. Technol., 5: 289-92(Summer 1968).

The tour of the portable cesium irradiator from Arlington, Mass., Aug. 11 to Seattle, Wash., on Nov. 30, 1967, is described. Products irradiated included potatoes, onions, tomatoes, bananas, oranges, pepper seed, holly, and mushrooms. Over 30 thousand lb of products were irradiated in this period. (auth)

31312 MAIZE POLLEN STERILIZATION BY MEANS OF γ RADIATIONS. Popa, Al. Apicultura (Bucharest), 20: No. 6, 13-16(1967). (In Rumanian).

Pollen sterilization by means of γ radiation is a new, original, and reliable method that induced reasonable alterations without changing the biological value of the product, at least as far as its use in bee feeding was concerned. The method described is part of the large-scale utilization of ionizing radiation program in the preservation of several foodstuffs. However, further investigations on the chemical changes occurring in the structure of the main pollen components are required. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

Metals and Alloys

Refer also to abstracts 30730 and 30731.

31313 COMPILATION OF THERMODYNAMIC DATA. Waddington, G. pp 829-40 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

The historical background of the Committee on Data for Science and Technology (CODATA), programs for compilation of numerical data, use of internationally approved symbols, units, constants, terminology, and nomenclature, coordination and integration of governmental research, and supplementation and expansion of existing programs are reviewed. Phases within the CODATA program include nuclear properties, atomic and molecular properties, solid state properties, thermodynamic and transport properties, chemical kinetics, colloid and surface properties, mechanical properties, and general properties. (P.G.C.)

31314 BERYLLIUM. Schilling, S. A. (Battelle Memorial Inst., Columbus, Ohio). Eng. Mining J., 169: 128-30(Mar. 1968).

Production, consumption, prices, new applications and demand-outlook for Be metal are reviewed. (P.G.C.)

31315 COLUMBIUM. Buttner, F. H. (Battelle Memorial Inst., Columbus, Ohio). Eng. Mining J., 169: 112-14(Mar. 1968).

Production, imports, consumption, and uses of Nb, in the U. S. during 1967, are reviewed as are prices and short-term demand outlook. Particularly noted is a shift from traditional uses of Nb to space-age uses. (P.G.C.)

31316 MOLYBDENUM. Sawyer, H. A. Jr. (Climax Molybdenum Co., New York). Eng. Mining J., 169: 137-9(Mar. 1968).

Production, prices, consumption, and major industrial uses for Mo in 1967 are reviewed. Also discussed are recent market developments and the status of the U. S. stockpile of Mo. (P.G.C.)

31317 RARE EARTHS. Kruesi, Paul R. Eng. Mining J., 169: 136-7(Mar. 1968).

Production and sales of rare earth raw materials and processed rare earths in 1967 are reviewed as are new applications of rare earths in steel manufacturing and in permanent magnets. (P.G.C.)

31318 TANTALUM. Emerson, Mark E. Eng. Mining J., 169: 115-16(Mar. 1968).

Data on production, imports, prices, end uses of Ta metal, and exploration programs for Ta ores are reviewed and the status of the U. S. stockpile of Ta is discussed. (P.G.C.)

31319 TUNGSTEN. Stevens, Richard F. Jr. Eng. Mining J., 169: 139-41(Mar. 1968).

Data for 1967, on production, consumption, average prices, imports, exports, and the short-term demand-outlook for W are reviewed. (P.G.C.)

31320 ZIRCONIUM–HAFNIUM. Olson, John B. (American Metal Climax Inc., New York). Eng. Mining J., 169: 134-5 (Mar. 1968).

Production, consumption, and prices in 1967 for Zr–Hf metals and products are reviewed. Increased use of Zr tubing for fuel rods, end caps and nuclear reactor structural shapes is discussed. (P.G.C.)

31321 Zr, Hf, AND Ti NEWSLETTER, JUNE 1967. Akron, Ohio, AMAX Specialty Metals, Inc., 1967. 16p.

The Hf reports concern the promise of Hf–20 Ta alloy for use in aerospace applications at very high temperatures, Hf–7 Mo and Hf–40 Ta braze alloys, solid solubility of Hf in Cu at 970°C, properties of Cr-base and Nb-base alloys containing Hf, and phase studies of Hf–Rh alloys. Discussions of the wear resistance of various Zr alloys and coatings for these alloys, corrosion of Zr in oxygenated H_2SO_4 solutions at 100 to 300°C, theoretical considerations of the oxidation of Zr, posttransition oxidation behavior of sponge and crystal-bar Zr, compatibility of Zr and Zr-base alloys with liquid and vapor alkali metals, brazing alloys of Ti and Zr, and phase diagrams of various systems including Zr are presented in the reports on Zr. The alloying properties of Zr are also discussed. The reports on Ti include a report concerning the use of Ti heat exchanger tubes in a desalination plant, Ti process equipment for other type plants, compatibility of Ti alloys with compressed methanol, metallography and structural study of Ti–6 Al–4 V, and a plasma arc welding process for butt-type joints in Ti. New developments in the compounds of the three metals are reviewed. 158 ref. (B.L.M.)

31322 Zr, Hf, AND Ti NEWSLETTER, APRIL 1968. Akron, Ohio, AMAX Specialty Metals, Inc., 1968. 15p.

Current developments in corrosion, uses, and fabrication of Zr, Hf, and Ti metals are reviewed. New alloys of these metals are reported, and new developments in research on their compounds with B, C, N, O, and certain other nonmetals are reviewed. There are 168 references cited. (B.L.M.)

31323 Zr, Hf, AND Ti NEWSLETTER, SEPTEMBER 1967. Akron, Ohio, AMAX Specialty Metals, Inc., 1967. 15p.

The reports concerning Hf research deal with two new Ta–W–Hf–Y alloys and protective coatings for these, a Nb-base alloy with high corrosion resistance in hot acids, coating of Hf metal with hafnium oxide to improve corrosion resistance, two Ta-base alloys containing Hf having improved thermal-aging and mechanical properties, a W-base alloy containing Hf and C and having the highest creep strength at 3200°F of any of the refractory metals, and a phase diagram for Hf–Cr. The reports on Zr deal with various corrosion studies in different media, a process for increasing the wear resistance of Zr, Zr-base brazing alloys, structural studies of Zr–4 Nb, fabrication and mechanical properties of Zr and Zircaloy-2, superplasticity of Zircaloy-4, various alloys of Zr with Nb, and a new Ti-base alloy containing Sn, Zr, Al, Mo, and Si. The Ti reports discuss its resistance to chloride corrosion, other corrosion studies, protective coatings for Ti and its alloys, fabrication techniques, and crystal structures. 155 ref. (B.L.M.)

31324 Zr, Hf, AND Ti NEWSLETTER, JANUARY 1968. Akron, Ohio, AMAX Specialty Metals, Inc., 1968. 16p.

The following developments in the metallurgy of Hf are reported: phase studies of the Hf–C system, the effects of additions of Hf on the solubility of O and N in Nb, phase diagrams for the Hf–Nb–C, Zr–Nb–Hf systems, oxidation characteristics of Hf–Ti alloys, and studies of the Ta–8 W–2 Hf alloy for containment of alkali metals. Reports on Zr alloys concern corrosion resistance; corrosion and oxidation; forging, welding, and embrittlement studies of Zr–2.5 Cu alloy: effects of H and hydrides on Zr and its alloys: and Zr as an alloying addition. The Ti reports deal with corrosion, refining techniques, fabrication techniques, and texture strengthening. A new method for the production of Zr from zircon and recent developments in some of the compounds of the three metals are discussed briefly. 182 references. (B.L.M.)

31325 ACTIVATED SINTERING. A REVIEW. Shaler, Amos J. pp 807-28 of Sintering and Related Phenomena. Proceedings of the International Conference, Univ. of Notre Dame. Kuczynski, G. C.; Hooton, N. A.; Gibbon, C. F. (eds.). New York, Gordon and Breach, Science Publishers, 1967.

See CONF-650644.

Activated sintering applies to heating a powder compact in the presence of a gaseous or a solid additive and to the sintering of compounds which have deliberately been made non-stoichiometric in composition. Experiments and industrial applications performed are reviewed and data cited to formulate the knowledge on sintering in the various applications. A listing of 34 references is included. (J.C.W.)

Corrosion and Erosion

Refer also to abstracts 32834, 32895, 32926, 33109, 33153, 33167, and 33169.

31326 EFFECTS OF OXYGEN IN A TYPE-316 STAINLESS-STEEL Cb–1 PERCENT Zr LIQUID POTASSIUM SYSTEM. Goldman, Kurt (United Nuclear Corp., Elmsford, N. Y.); McKee, John M. Trans. Amer. Nucl. Soc., 11: 115(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31327 COMPATIBILITY OF NaK WITH TYPE-316 STAINLESS STEEL AND Nb–1 PERCENT Zr ALLOY IN A HEAT REJECTION SYSTEM. Litman, A. P.; Leonard, W. J.; Lloyd, D. B. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 117(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31328 CORROSION AND THE MAINTENANCE ENGINEER. Wilson, C. L.; Oates, J. A. London, Newnes, 1968. 191p. 35s.

Discussion is presented on the following topics: theory of corrosion; A.B.C. of corrosion; and aspects of anti-corrosion methods. (UK)

31329 INVESTIGATION OF THE OXIDATION PROCESSES OF ALLOYS OF THE NIOBIUM–TANTALUM SYSTEM AT 550 TO 1050°. Korobkov, I. I.; Osipov, V. V.; Zapleshko, N. N. (Moscow Engineering-Physics Inst.). Fiz. Metal. Metalloved., 25: 85-93(Jan. 1968). (In Russian).

The kinetics of the oxidation of the alloys of the Nb–Ta system at 550 to 1050°C and the structure and composition of oxide films and very thin layers of slag were investigated. For alloys up to 30 at. % Ta, low-temperature (600 to 700°C) and high-temperature (800 to 1000°C) anomalies were observed in the temperature dependence of the oxidation rate. The anomalies consisted in a decrease of the oxidation rate with increase of the temperature. On the rest of the alloys, only low-temperature anomalies were noted. The displacement of the temperature for the beginning of the anomaly to the high-temperature side occurred to the extent of the increase of the Ta in the alloy. The displacement is connected with the solution of Nb_2O_5 and Ta_2O_5 in the films. (tr-auth)

31330 CREVICE CORROSION OF TITANIUM IN AQUEOUS SALT SOLUTIONS. Griess, John C. Jr. (Oak Ridge National Lab., Tenn.). Corrosion, 24: 96-109(Apr. 1968).

Crevice corrosion of Ti in high temperature NaCl solutions was investigated. Corrosion occurred only in very restricted crevices and attack was greater the higher the salt concentration. It was shown that crevice corrosion occurs because of the development of a low (~1) pH in the solution within the crevice and is not specific to chloride solutions. Crevice attack was demonstrated in iodide, bromide and sulfate solutions. An electrochemical polarization technique was used to determine the effect of temperature and hydrogen and chloride ion concentrations on the corrosion of Ti and to determine the corrosion characteristics of several Ti alloys. Results indicate that Ti alloys containing sufficient Mo, Ni, or Pd are more resistant to nonoxidizing acid solutions than commercially pure Ti and, therefore, should be more resistant to crevice corrosion. (auth)

31331 EVALUATION OF OXIDATION RATES FOR ALPHA ZIRCONIUM. Rosa, C. J. (Univ. of Denver, Colo.). J. Less-Common Metals, 15: 35-41(May 1968).

Theoretical evaluation of oxidation rates of α-zirconium at 850, 800, and 750°C is given in terms of a unidirectional volume diffusion model for a two-phase system. The calculated results conform to the parabolic rate law, $\Delta m/A = k_p\sqrt{t}$, and are in good agreement with experimental determinations. It is possible to express the parabolic rate constants, k_p, for both the oxide phase and zirconium in terms of diffusion parameters. The amount of oxygen confined to the metal phase is about 98% of the total amount of oxygen consumed during oxidation of zirconium for periods up to 144 hr. (auth)

31332 CONTRIBUTION TO THE DISCUSSION ON PITTING CORROSION OF STAINLESS STEELS. Steensland, O. (Uddeholms Aktiebolag Hagfors, Sweden). Anti-Corros. Methods Mater., 15: 8-11; 19(May 1968).

Discussion is presented on the following topics: chemical composition—effects of nitrogen; surface finish; effects of temperature; and pH of electrolyte. Among conclusions reached are the following: it would seem that only in conjunction with a Mo addition does nitrogen manifestly improve pitting resistance; for low temperature service more attention should be paid to surface condition than for high temperature duty; susceptibility to pitting increases with temperature; at temperatures up to 90°C the effect of Mo on pitting is almost constant; pitting is less likely to occur at higher pH values, and can be completely suppressed at high pH values. (U.K.)

Preparation and Fabrication

31333 (BDX-613-103) STRENGTHENING OF STEEL BY MARSTRAINING WITH HIGH-ENERGY-RATE FORMING EQUIPMENT. Gibson, Donald L.; Stevens, Charles A. (Missouri Univ., Columbia. Dept. of Mechanical Engineering). May 10, 1967. Contract AT(29-1)-613. 130p. (EP-6984006; E-11). Dep. CFSTI.

The feasibility of utilizing high-energy-rate forming techniques to produce ultra-high strength steel parts by the marworking process was investigated. The effects of the strain rate during the marworking process, the amount of strain during marworking, and heat-treatment temperatures on the physical properties of H-11 and H-13 tool steel were evaluated. It was found that the shape of the stress-strain curves and the physical properties of these materials could be controlled by varying the amount of marwork and the tempering temperature for both high and low strain rate marworking. The strain rate utilized in the marforming process did not adversely affect the physical properties of the steels and yield strength values of 300,000 psi to 350,000 psi were obtained with less than 4% marstrain for both steels. As the yield strength of the steels was increased beyond 300,000 psi, localized yielding occurred which limited the elongation-to-failure for subsequent loading. However, the steels were not considered brittle and even at the maximum strength test bars exhibited a ductile cup and cone fracture with a reduction of area in excess of 20%. From these tests, it was concluded that high-energy-rate forming equipment can be used to produce ultra-high-strength sheet metal parts utilizing the marforming thermo-mechanical treatment. (auth)

31334 (ORNL-4246, pp 89-105) EVALUATION OF NIOBIUM SOURCE MATERIALS SUITABLE FOR ELECTRON BEAM FLOAT ZONE MELTING. Reed, R. E.; Tucker, R. P.; Brooks, C. L. (Oak Ridge National Lab., Tenn.).

Material characterization results are presented on Nb metal from three sources (Wah Chang, DuPont, and CIBA) after purification and crystal growth using electron-beam float-zone melting. The results included chemical analyses, resistance ratios, and flow stresses at the lower yield point. Annealing effects are considered. (D.L.C.)

31335 (RMI-10) SEMI-ANNUAL PROGRESS SUMMARY [ON METAL FABRICATION], JULY–DECEMBER 1967. (Reactive Metals, Inc., Ashtabula, Ohio). Feb. 12, 1968. Contract AT(30-1)-1405. 53p. Dep. CFSTI.

The fabrication process for forging NPR billets to co-extrusion sizes has been modified. The new process has an increased production rate and offers even greater yields over the standard extrude-machine process used for NPR co-extrusion billet production. The current status of precision extrusion in terms of dimensional control possible and problems still to be solved has been defined. Alternate routes to take immediate advantage of cost savings are now being considered and tested. Operational procedures have been defined for swaging uranium wire as small as 0.032 in.-dia from both unalloyed and U-base $^3/_4$% titanium stock. (auth)

31336 (UCRL-50403) PRODUCTION OF PLUTONIUM METAL BY DIRECT REDUCTION OF THE OXIDE. Wade, W. Z.; Wolf, T. (California Univ., Livermore. Lawrence Radiation Lab.). Feb. 22, 1968. Contract W-7405-eng-48. 16p. Dep. CFSTI.

A single-unit process was developed for the rapid production of massive plutonium metal directly from its oxides. The process consists of the following steps: the reduction of plutonium oxides with calcium metal, extraction of the calcium oxide reaction product with molten calcium chloride, and the quantitative separation of the two immiscible molten-metal phases by the immiscible salt solution. Reduction, separation, and massive metal yield efficiencies are in excess of 99.96%; batch cycle time (completely independent of batch scale) is 15 min; and the single waste product is far below recovery level and is discardable as a small-volume solid waste. (auth)

31337 (Y-1618) METALLOGRAPHIC PREPARATION OF HOLMIUM. Dobbins, Anna G. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). May 28, 1968. Contract W-7405-eng-26. 14p. Dep. CFSTI.

Cathodic etching of holmium metal under an argon atmosphere produced a structure that was essentially identical in major details to that produced by careful hand polishing or chemical polishing. In addition, the surface produced was relatively reaction free. (auth)

31338 DIFFUSION WELDING OF AUSTENITIC CHROMIUM-NICKEL STEELS TO ALUMINIUM. Lehrheuer, W. (Kernforschungsanlage Juelich, Ger.). Kerntechnik, 10: 208-13(Apr. 1968). (In German).

Because of the metallurgical disparity, joining of stainless steel to aluminum is very difficult. It is impossible to join these metals by the usual processes of fusion welding and brazing. A method is described to join both metals under high pressure and with temperatures of about 500°C. According to pressure, temperature and time brittle intermetallic layers are formed, the thickness of which must be limited to a few μ by choice of the process parameters. Although a very simple apparatus was used, good bonding between stainless steel and $AlMg_3$ was obtained with a satisfactory consistency of results. The strength of the bonding was sometimes beyond the strength of the $AlMg_3$-base-material. The ductility of these joints was satisfactory. (auth)

31339 PRODUCTION AND PROPERTIES OF REACTOR FUELS. Ermischer, Wolfgang. Neue Hutte, 12: 486-91 (Aug. 1967). (In German).

The performance of a large number of U and Pu compounds as nuclear fuels is studied. Next to metallic U and U alloys, the most frequently used fuel material is UO$_2$; however, the more advanced reactors require fuel elements with higher conductivity and density and with better thermal and radiation stability. These include carbides and nitrides of U and Pu. New production methods necessary to manufacture these materials are mentioned. (Rev. Metal Lit.)

31340 TENSILE PROPERTIES OF ELECTRON-BEAM-WELDED 304 STAINLESS STEEL. Arbel, A. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc., 11: 139-40(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31341 THE POTENTIOSTATIC METHOD FOR ELECTROLYTIC ETCHING OF U–Nb ALLOYS. Mihajlovic, A.; Mance, A. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). J. Nucl. Mater., 26: 267-72(1968).

The electrochemical behavior of U–3 wt % and U–4 wt % Nb alloys in concentrated aqueous citric acid was investigated by means of the potentiostatic method. The polarization curves, "Tafel" slope, α, and i_0 were determinated. This method can be applied for selective etching of the U–Nb alloys with banded α'' martensite. Using low current densities it is possible to reveal fine microstructural details such as dislocation and etch-pits. The method is very simple and avoids the use of aggressive etchants. (auth)

31342 SOME PROBLEMS ON PREPARATION OF POROUS ARTICLES OF TUNGSTEN. Pavlovskaya, E. I.; Goryacheva, Z. V. Porosh. Met., Akad. Nauk Ukr. SSR, No. 4, 37-40(Apr. 1968). (In Russian).

Experiments were conducted on the nickel filler effect on some properties of sintered filter materials of spherical tungsten powder. It is established that the introduction of 0.2 to 0.5% of nickel permits the mechanical properties of the sintered filtering elements of tungsten to be improved. (auth)

Properties Evaluations

Refer also to abstracts 30575, 30888, 31334, 31422, 31463, 32781, 32805, and 33156.

31343 (AGN-8195(Vol.1)) THERMOPHYSICAL AND HEAT TRANSFER PROPERTIES OF ALKALI METALS. Achener, P. Y.; Mackewicz, W. V.; Fisher, D. L.; Camp, D. C. (Aerojet-General Corp., San Ramon, Calif. Nuclear Div.). Apr. 1968. Contract AT(04-3)-368. 259p. Dep. CFSTI.

A compilation of the latest available data are presented. The data were obtained by a comprehensive literature search and evaluated for selection of the best values. (J.R.D.)

31344 (KAPL-M-6731) A STUDY OF BORON SEGREGATION IN BORON-STAINLESS STEEL ALLOY. Dufour, R. F. (Knolls Atomic Power Lab., Schenectady, N. Y.). Sept. 12, 1967. Contract W-31-109-eng-52. 12p. Dep. CFSTI.

Boron–stainless steel from one material supplier was studied in order to determine the extent of boron variability at various stages of the manufacturing process. This investigation examined three phases of the manufacturing process; the ingot, the billet, and the finished wire. The distribution of boron, which was found in the alloy from the particular supplier studied, happened to be greatest in the radial direction—as much as 20% variability from center of billet to edge. The degree of boron variability which was found does show that manufacturing processes can be responsible for differences which exceed present specification requirements. This study also points out that a need exists for closer attention to product sampling techniques. (auth)

31345 (ORNL-4246, pp 38-41) PROPERTIES OF 12-INCH-THICK ASTM A-533-B, CLASS I, STEEL. Berggren, R. G.; Jones, T. N. (Oak Ridge National Lab., Tenn.).

Material characterization tests were conducted on the central region of the 12-inch plate. Variations of drop weight NDT temperature, strength, ductility, and hardness with depth are shown. (D.L.C.)

31346 (ORNL-4246, pp 84-8) SPARK-MACHINING DAMAGE IN NIOBIUM SINGLE CRYSTALS IN INDICATED BY ETCH FIGURES. Guberman, H. D. (Oak Ridge National Lab., Tenn.).

NIOBIUM—dislocation distribution around spark-machined notch in single crystals of, (E) (D.L.C.)

31347 (STI/PUB-162) THERMODYNAMICS OF NUCLEAR MATERIALS, 1967. Proceedings Series. Proceedings of a Symposium on the Thermodynamics of Nuclear Materials With Emphasis on Solution Systems held in Vienna, 4–8 September 1967. (International Atomic Energy Agency, Vienna (Austria)). 1968. 871p. (In several languages). (CONF-670915). IAEA: \$18.00; Austrian Schillings 465,-; £ 7.10.0; F Fr 88,20; DM 72,-.

A total of 55 papers is presented which emphasize recent investigations on solution systems, molten salts, alloys, semi-metallic compounds, transition metal and actinide carbides, and solid solutions. A separate abstract was prepared for each of 53 of the papers. Two papers were previously abstracted in NSA as 22: 4149 and 22: 21761. (P.G.C.)

For abstracts of individual papers see: 30518, 30669, 30756, 30788, 31313, 31361–31364, 31389–31396, 31448–31451, 31462–31475, 31477–31481, and 31498–31510.

31348 (Y-1617) ALUMINUM ION PLATING OF URANIUM–MOLYBDENUM ALLOY FAST-BURST REACTOR ELEMENTS. Bell, R. T. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). June 6, 1968. Contract W-7405-eng-26. 27p. Dep. CFSTI.

Ion plating of thin (<0.2 mil) aluminum coatings on fast-burst reactor parts fabricated from uranium-10 percent molybdenum alloy was evaluated as a method of protecting the alloy from oxidation and as a means of containing the fission products. A number of core rings were plated with nickel while other rings were ion plated with aluminum so that a comparison between the two coatings could be made. During the ion plating of aluminum and subsequent heat treatment, certain uranium-aluminum intermetallic compounds (UAl$_2$, UAl$_3$, and UAl$_4$) were formed. During the process of testing to destruction, these rings encountered fissions in excess of 10^{17} and temperatures in excess of 700°C during which the nickel plating spalled severely while the aluminum and the uranium-aluminum intermetallics remained adherent to the alloy. (auth)

31349 THE TEMPERATURE DEPENDENCE OF SLIP IN α-URANIUM. Daniel, J. S.; Jean-Louis, F.; Lacombe, P. (Ecole des Mines, Paris. Faculte des Sciences, Orsay, France). J. Nucl. Mater., 26: 319-24(1968).

Slip in α-uranium was studied, principally in the temperature range 400 to 660°C, by performing mechanical tests on single crystals. Both the highly polygonized crystals prepared by the phase shift method and more perfect crystals obtained using the critical strain-anneal method were employed. Slip planes were identified by the two surfaces method, and the rotation of the lattice during tension tests was studied in order to identify slip directions. The critical resolved shear stresses for slip on the two systems (110) $[1\bar{1}0]$ and (001) [100] decreased rapidly above about 400°C. These effects are discussed in the light of recent theoretical work on the deformation of α-uranium. (auth)

31350 SLIP MODES OF ALPHA-URANIUM. Yoo, M. H. (Michigan State Univ., East Lansing). J. Nucl. Mater., 26: 307-18(1968).

A detailed analysis is given of the slip modes of α-uranium in terms of its crystal structure and elastic properties. The effective shear moduli, dislocation line energies, dislocation widths, and Peierls-Nabarro stresses were calculated for the various slip systems by applying anisotropic elasticity theory of dislocations. Attempts are made to interpret the deformation phenomena reported on α-uranium in the light of the calculated dislocation parameters. The fact that the (010) [100] slip system is the primary one observed at room temperature, whereas the (001) [100] slip system operates only as a secondary slip mode in cross-slip is consistent with the calculated results. A calculation of the temperature dependence of such dislocation parameters between –200 and 650°C provides an adequate explanation for the prevalence of the (001) [100] slip over the (010) [100] slip at temperatures above 325 to 350°C. (auth)

31351 EFFECTS OF COLD WORK ON THE STRESS-RUPTURE BEHAVIOR OF AUSTENITIC STAINLESS-STEEL CLADDING. Atkins, D. F.; Lee, W. T. (Atomics International, Canoga Park, Calif.). Trans. Amer. Nucl. Soc., 11: 140-1 (June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31352 MOBILITIES OF DISLOCATIONS IN α-URANIUM. Saxl, I.; Otruba, J. (Inst. of Nuclear Research, Rez, Czech.). J. Nucl. Mater., 26: 325-30(1968).

Anisotropic elasticity was used to calculate the energies and easy glide parameters ξ/b for dislocations of different slip systems in α-uranium. The criterion of a low dislocation energy and a high value of ξ/b were employed to explain the choice of the principal slip system in the different temperature ranges. The values of the Peierls-Nabarro stress were estimated for two cases with interatomic binding forces of different character and a tentative explanation is proposed for the temperature dependence of critical shearing stress for the three principal slip systems. (auth)

31353 EFFECT OF GRAIN-BOUNDARY MIGRATION ON THE XENON DISTRIBUTION IN ALUMINIUM. Kawasaki, S. (Japan Atomic Energy Research Inst., Ibaraki). J. Nucl. Mater., 26: 338-40(1968).

Aluminum samples were attached to Al-20 wt % U foils and then irradiated with neutrons so that fission products were introduced into the specimens by recoil. The ^{133}Xe contents in each piece of the specimens are shown. No significant difference was observed in the xenon content between regions that contained grain boundaries and regions that did not. Sweeping of inert gases by moving grain boundaries did not have a significant effect. (M.C.G.)

31354 INTERRELATIONSHIP BETWEEN DEFORMATION AND CRACK NUCLEATION AND PROPAGATION IN ZIRCONIUM CONTAINING HYDRIDE PRECIPITATES. Warren, M. R.; Beevers, C. J. (Univ. of Birmingham, Eng.). J. Nucl. Mater., 26: 273-84(1968).

The nucleation and propagation of cracks in hydride precipitates in zirconium containing 50 ppM hydrogen and tested at −196°C at a strain rate of ~5 × 10^{-4}/sec were investigated. It was established that crack nucleation within the hydrides takes place because of the intersection of parallel-sided $\{11\bar{2}1\}$ type twins and $\{10\bar{1}0\}$ slip bands with the hydrides. The relative importance of these precipitate-matrix deformation interactions in initiating the final failure of the composite material is considered and it is also shown that the nucleation process is independent of the orientations of the hydrides to the tensile axis. However, the subsequent propagation of cracks within the hydrides shows a strong dependence on the hydride orientation with respect to the tensile axis and it is demonstrated that the stress normal to the precipitates is probably a controlling factor in the crack propagation process. (auth)

31355 STRUCUTRE AND PROPERTIES OF YTTRIA–ZIRCONIUM DISPERSIONS. Rezek, J. (Canadian Westinghouse Co., Hamilton, Ont.); Childs, B. G. J. Nucl. Mater., 26: 285-99(1968).

Uniform dispersions of fused and sized yttria particles in zirconium were produced by a powder metallurgy route in which particle-free matrix volumes are efficiently broken up in an intermediate stage of rehydriding and recrushing. High-density specimens sintered at 1200°C or at 1000°C followed by rolling at 950°C were examined by replica and transmission electron microscopy. From the observed rounding of the larger particles and disappearance of many of the finer ones it appears that yttria is not chemically stable in zirconium under present fabricating conditions. The main effect of the particles on the microstructure was to pin moving grain boundaries during sintering and so reduce the average grain size in the dispersions. In the hot-rolled specimens numerous dislocation arrays, forming low-angle subgrain boundaries, were present. These too appeared to interact to some extent with the particles. Stress rupture tests at 500°C on rehydrided and resintered specimens showed no effect of the yttria particles for concentrations up to 2 vol %. At higher concentrations the properties progressively improved culminating in a ten-fold increase in rupture time at 5 vol % yttria. The hot-rolled specimens showed more complex behavior in which the rupture time first decreased to a minimum at about 2 vol % yttria and then increased again. By 5 vol % the rupture time was, respectively, 3 and 50 times greater than for hot-rolled and sintered zirconium without yttria. Corresponding tests on selected zirconium alloys showed that the best hot-rolled dispersions were comparable in rupture properties to hot-rolled Zircaloy-2 and annealed Zr−2.5 wt % Nb. They are still much inferior, however, to ultra-high-strength alloys such as annealed Zr−1.5 wt % Al−0.5 wt % Mo. (auth)

31356 SINTERING AND RELATED PHENOMENA. Proceedings of the International Conference held in June 1965, University of Notre Dame, Ind. Kuczynski, G. C.; Hooton, N. A.; Gibbon, C. F. (eds.). New York, Gordon and Breach, Science Publishers, 1967. 901p. Professional $22.50; Reference $50.00. (CONF-650644).

A total of 41 papers was presented at the conference. A separate abstract was prepared for each of 18 of these. Papers for which no abstracts were prepared are concerned with diffusion and solid state reactions, sintering, and activated sintering. (J.R.D.)

For abstracts of individual papers see: 30755, 31325, 31386–31388, 31445, 31446, 31492–31497, 31511–31514, and 31519.

31357 METALLIC MATERIALS. Ross, R. B. London, Chapman and Hall, 1968. 952p. 126s.

Brief details are given on all metallic materials, including physical properties, general metallurgical characteristics, thermal treatment, welding and brazing, flaw detection, corrosion protection, machinability, and uses. Nuclear materials include Al, Be, B, Ge, Mg, Mo, Nb, Pu, Ra, rare earths, Na, steels, Th, Ti, W, U, V, and Zr. (UK)

31358 PHOTOELECTRIC PYROMETER FOR MEASUREMENT OF THE ACTUAL TEMPERATURE OF TUNSTEN. II. CALCULATION OF THE CHANGE OF THE EFFECTIVE WAVE LENGTH OF THE PYROMETER. Dmitriev, V. D.; Kholopov, G. K. Zh. Prikl. Spektrosk., 8: 416-20(Mar. 1968). (In Russian).

The magnitudes of the deviation of the effective wavelength of the previously described pyrometer from the characteristic wavelength λ_x tungsten, $\Delta\lambda_{x\,\mathrm{eff}}$, arising because of the change in the spectral composition of the radiation with change in temperature of the tungsten and width of the separable spectral regions, were quantitatively evaluated. The temperature corrections, connected with these deviations, were calculated. Two cases were examined. For triangular apparatus function, when the inlet and output apertures are adjusted monochromatically, it was shown that $\Delta\lambda_{x\,\mathrm{eff}}$ is proportional to the square of the width of the aperture. In the general case with irregular aperture, $\Delta\lambda_{x\,\mathrm{eff}}$ is proportional to the sum of the squares of the aperture widths. The method of calculating $\Delta\lambda_{x\,\mathrm{eff}}$ and the temperature correction was shown on a concrete example. (tr-auth)

31359 INVESTIGATION OF THE DIFFUSION MOBILITY OF CARBON IN TUNGSTEN AND MOLYBDENUM BY THE INTERNAL FRICTION METHOD. Shchelkonogov, V. Ya.; Aleksandrov, L. N.; Piterimov, V. A.; Mordyuk, V. S. (Mordovian State Univ., USSR). Fiz. Metal. Metalloved., 25: 80-4(Jan. 1968). (In Russian).

The diffusion mobility of carbon in W and Mo was studied at low-temperature impurity peaks, characteristic of the diffusion in solid solution of the intrusion type. The activation energy was determined and the diffusion coefficients were calculated. The relation of the low-temperature peaks and the grain dimensions was examined. From fracture curves of the size of the internal friction versus the length of carbonization, the limiting solubility of C in W was found. A comparison was made of the value of the diffusion parameters found by the internal friction and the thermionic emission methods. An increase of the maximum internal friction in W and Mo during increase of the concentration of C was found. (tr-auth)

31360 VYSOKOTEMPERATURNYYE MATERIALY. (High-Temperature Materials). Marmer, Eduard Nikitovich; Gurvich, Osip Solomonovich; Mal'tseva, Lyudmila Fedorovna. Moscow, Izdatel'stvo Metallurgiya, 1967. 214p.

High temperature materials used in vacuum in inert media are discussed. The properties of refractory metals and oxides, and graphite and refractory carbides are summarized. Some specific features in measuring temperatures with thermocouples and optical pyrometers are discussed. Properties of W, Mo, Re, Ta, Nb, and refractory metal alloys are given. The properties of refractory aluminum oxide, zirconium oxide, magnesium oxide, beryllium oxide, and thorium dioxide are listed. (J.C.W.)

31361 REVIEW OF ALLOY THERMODYNAMICS. Kubaschewski, O. (National Physical Lab., Teddington, Eng.). pp 685-98 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

Suitable experimental methods for the determination of heats and free energies of formation of alloys involving metals of interest in reactor technology are reviewed. Available data are tabulated. The little that is known about the underlying causes of stability is discussed. 53 references. (auth)

31362 HEATS OF DISSOLUTION OF TIN, SILVER, SILICON, AND IRON IN LIQUID ALUMINUM. Mathieu, J. C.; Jounel, B.; Desre, P.; Bonnier, E. (Centre National de la Recherche Scientifique, Grenoble, France). pp 767-76 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968. (In French).

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

The use of interaction models in estimating the mixing enthalpy of binary metallic solutions is always associated with one or more adjustable parameters. With a view to determining one of these, the dissolution of Sn, Ag, Si, and Fe in Al at 700°C was studied. The difficulties presented by this solvent are analyzed in each specific case. The measurements, carried out over a range of concentration below 0.03 g-atom, make it possible to reach the limiting values of partial enthalpy and its slope for each element. The information thus obtained serves as a basis for discussion of the asymmetrical nature of the mixing enthalpy of binary metallic solutions. (auth)

31363 DETERMINATION OF THE THERMODYNAMIC ACTIVITY OF IRON, NICKEL, ALUMINUM, AND COPPER IN DILUTE SOLUTIONS IN LIQUID BERYLLIUM. Bienvenu, G.; Potard, C.; Schaub, B.; Desre, P. (CEN, Grenoble, France). pp 777-87 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968. (In French).

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

A method of determining activities of aluminum, copper, iron and nickel in dilute solutions in liquid beryllium is described. Iron-tin solutions were studied to establish an expression giving Log $\gamma^{\infty}_{Fe(Sn)}$ at all temperatures, using the phase diagram. In view of the mutual solubilities of tin and beryllium, and lead and beryllium, a correction was made so as to get the values of the ternary interaction coefficients $\epsilon^{(Be)}_{Fe}$ in tin and $\epsilon^{(Be)}_{Ni}$ in lead. (auth)

31364 HEATS OF FORMATION OF INTERMETALLIC COMPOUNDS OF PLUTONIUM WITH GALLIUM AND TIN. Akhachinskii, V. V.; Kopytin, L. M. (State Committee of Atomic Energy Recovery, Moscow). pp 789-93 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968. (In Russian).

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

Intermetallic compounds of plutonium with gallium and tin were produced. The heat of dissolution in 6 M HCl of these compounds and their component elements was determined. On the basis of the data obtained, the standard heats of formation were calculated for Pu_3Ga, $PuGa_2$, $PuGa_6$ and $PuSn_3$, and assessed for Pu_5Ga_3, PuGa, $PuGa_3$ and $PuGa_4$. (auth)

31365 ADSORPTION AND NUCLEATION OF ZIRCONIUM ON TUNGSTEN FIELD EMITTERS. Collins, R. A.; Blott, B. H. (Univ. of Southampton, Eng.). Surface Sci., 10: 349-68(Jan. 1968).

The adsorption of zirconium on clean tungsten, at residual gas pressures below 1×10^{-10} torr, has been studied by field emission microscopy. It was necessary to outgas the Zr above 2400°K to obtain reproducibility. The gases evolved during degassing of the zirconium were predominantly Co, CH_4, and H_2. Mass spectra of the evaporant flux showed no tungsten or oxide contamination after thorough outgassing. It was found that heating below the $\alpha-\beta$ phase transition temperature of Zr (1135°K) resulted in the formation of large cap-shaped nuclei on the high index planes, while above this temperature the deposit became smoothed on the {100} planes. A model is proposed involving a close-packed square array of Zr atoms on the W (100). It is concluded that the two temperature regions are eminently suitable for studying epitaxy following the initial growth processes of nucleation or of monolayer addition. The presence of contamination impeded both surface migration and nucleation and lowered the work function. (auth)

31366 EFFECTS OF AGEING ON THE MAGNETIC PROPERTIES OF ROLL-FLATTENED Mo–PERMALLOY RIBBONS. Ichinose, Yukio; Yamashita, Takeo; Taniguchi, Satoshi; Kobayashi, Masaru (Hitachi Ltd., Kokubunji, Japan). Nippon Kinzoku Gakkaishi, 32: 190-5(1968). (In Japanese).

The aging behavior in the magnetic properties, especially in the magnetic stress sensitivity S, was investigated in the Mo-Permalloy ribbon roll-flattened from fine wire. S always increases and sometimes changes sign from negative to positive due to aging, but the change is completely suppressed if the ribbon is kept at sub-zero. Three stages on aging have been found at the temperature range between room temperature (RT) and 250°C: the first stage occurs in RT to 75°C, the second in 125 to 200°C, and the third in 200 to 250°C, and the activation energies are calculated to be about 0.95, 1.5, and 2.2 eV, respectively. It is expected from these values that the aging process in the first stage is mainly caused by the vacancy cluster, in the second by the single vacancy, and in the third by the polygonization. The aging behavior observed in S can be explained by the presence of the K-state in Mo-Permalloy. (auth)

31367 MAGNETIC STRESS SENSITIVITY OF ROLL-FLATTENED Mo–PERMALLOY RIBBONS. Ichinose, Yukio; Yamashita, Takeo; Taniguchi, Satoshi; Hishiyama, Sadao; Kobayashi, Masaru (Hitachi Ltd., Kokubunji, Japan). Nippon Kinzoku Gakkaishi, 32: 184-9(1968). (In Japanese).

For high sensitive measurement of the magnetic stress sensitivity in very fine magnetic ribbons or wires, the quantity S is newly defined as the relative change with stress of the maximum emf in ac field. Measurements of S were made on the dependence of the roll-flattened Mo-Permalloy ribbons on the alloy composition and the working process before roll-flattening. S is closely related to the magnitude of magnetostriction λ_s, and a comparison of the change in the anisotropy field with applied stress on the same ribbon indicates that a change in λ_s of about 0.3×10^{-7} can be detected with a change in S of 1%/kg/mm². It is also found that the optimum output voltage of the ribbon made of Mo–Permalloy is obtained at $S \simeq 0$. (auth)

31368 ELECTRON BEAM MELTING OF THE REFRACTORY METALS. IX. DUCTILITY IMPROVEMENT OF THE ELECTRON-BEAM-MELTED MOLYBDENUM. Takasi, Tetsuya (Hitachi Ltd., Kokubunji, Japan). Nippon Kinzoku Gakkaishi, 32: 174-9(1968). (In Japanese).

The ductility improvement of the electron beam-melted molybdenum owing to the addition of small amounts of boron carbide, yttrium, beryllium, and germanium (0.02 to 0.1 wt %) has been studied mainly by means of the tensile test, the Charpy impact test, resistance ratio measurements, and O_2 gas analysis. The recrystallization temperatures of the electron beam-melted molybdenum wires with the addition of small amounts of boron carbide (below 0.05 wt %) and yttrium (0.02 wt %) were depressed 50 to 100°C than those of conventional molybdenum wires produced by the sintering method and the electron beam melting method without additions of alloying elements. And the yield stress of recrystallized wires was also about 15% lower than those of conventional molybdenum wires. The maximum elongation values of boron carbide- and yttrium-added molybdenum wires were 45% and 37%, respectively, and these values were 10 to 50% higher than that of conventional molybdenum wire. The ductile-to-brittle transition temperature of the electron beam-melted molybdenum rod was lowered by a small boron carbide addition (0.02 wt %) and an excellent ductility was obtained at room temperature for the fully recrystallized specimens. The measured residual resistivity of some electron beam-melted molybdenum wires with the addition of small quantities of boron carbide and yttrium was less than $\frac{1}{2}$ as compared to that of conventional molybdenum wire, and correspondingly the O_2 gas content was about $\frac{1}{2} \approx \frac{1}{14}$ of the O_2 gas content of conventional molybdenum wires. According to the electron diffraction patterns, the grain boundary inclusions of molybdenum ingots with the addition of yttrium were neither carbide nor oxide of molybdenum and yttrium, suggesting the presence of a complex compound, which was thought to be independent of grain boundary brittleness. (auth)

31369 STRAIN RATE DEPENDENCE OF THE TENSILE FLOW STRESS OF A Nb–Zr SOLID SOLUTION ALLOY. Yajima, Masami; Ishii, Mitsuru (Hitachi Ltd., Kokubunji, Japan). Nippon Kinzoku Gakkaishi, 32: 160-3(1968). (In Japanese).

It was found that the strain rate dependence of the flow stress of Nb–26 at. % Zr alloy was larger than that of pure Nb at all temperatures from 201 to 573°K. Above room temperature the strain rate dependence of pure Nb disappears, but that of the alloy is still significant. At 77°K, the alloy deforms by twinning and the flow stress becomes insensitive to the strain rate. The stress dependence of activation volume of this alloy was almost the same as that of Nb. The activation volume increases sharply with decreasing effective stress at low stress level, but it becomes nearly constant at the stress larger than 5 kg/mm², in the range 10 to 20 b^3. The activation energy however was always larger than that of pure Nb. It is suggested that the rate controlling mechanism for the flow of the alloy is the same as for Nb. Assuming that double kink formation is the rate controlling process, the kink energy of the alloy was determined as about 1.25 eV, which is nearly three times larger than that of Nb. (auth)

31370 ALLOY STEELS FOR PRESSURE VESSELS. Hellner, L. (Aktiebolaget Atomenergi, Bofors, Sweden). Nucl. Eng., 13: 426-8(May 1968).

Two new Swedish steels with improved properties (2RM2 0.06% C, 13% Cr, 6% Ni, and 2RM0 containing an additional 1.5% Mo) are proposed for reactor pressure vessels working at low and intermediate temperature. Details are given of the microstructure, mechanical and physical properties, corrosion resistance, weldability, and effects of radiation. (UK)

31371 DEVELOPMENT OF THE FREE-MACHINING, HIGH-STRENGTH, HIGH-CONDUCTIVITY Cu–Cr–Pb AND Cu–Cr–Zr–Pb ALLOYS. Saarivirta, Matti J. (Beryllium Corp., Reading, Pa.). Trans. Met. Soc. AIME, 242: 947-52(May 1968).

The relative machinabilities of the precipitation-hardenable Cu–0.9% Cr, Cu–0.25% Zr, and Cu–0.9% Cr–0.25% Zr alloys are improved from 18 to 80% by 0.75 to 1.25% Pb. The lead also improves the tensile strength, hardness, and resistance to softening of the Cu–Cr and Cu–Cr–Zr alloys. When the alloy containing 0.7 to 1.2% Cr, 0.10 to 0.25% Zr, 0.75 to 1.25% Pb, and balance copper is solution-annealed at 1000°C and then aged at 525°C, tensile strength of 65,000 psi, 16% elongation, 62 R_b hardness, and 84 to 87% IACS electrical conductivity are obtained. (auth)

31372 CONTINUOUS COMPILATION OF NEW REFERENCE DATA ON DIFFUSION PROCESSES IN ORGANIC SOLIDS AND THEIR MELTS. VOLUME 1, NUMBER 2. Diffus. Data., 1: No. 2, 1-100(Sept. 1967).

A compilation of new reference data on diffusion processes in organic solids and their melts is presented. The temperature and pressure ranges over which the data are applicable are given, as well as information on the experimental methods employed for their determination and on the purity and properties of the materials. Lists of references to new and previously published articles on diffusion processes are included. (R.C.K.)

31373 ERBIUM–HYDROGEN SYSTEM. Lundin, Charles E. (Univ. of Denver, Colo.). Trans, Met. Soc. AIME, 903-7(May 1968).

Pressure-temperature-composition data were obtained for the Er–H system. Measurements were carried out at 473 to 1223°K, the composition range of erbium to ErH_3, and the pressure range of 10^{-5} to 760 torr. Solubility relationships were established from these data throughout the system. Three solid-solution phases were delineated: metal solid solution, dihydride phase, and trihydride phase. The trihydride phase decomposes at about 656°K and 1 atm pressure. The dihydride phase is stable to about 1023°K, but becomes more deficient in hydrogen above this temperature. The equilibrium decomposition pressure-temperature relationships in the two-phase regions, erbium solid solution plus dihydride and dihydride plus trihydride, were determined. The differential heats of reaction in these two regions are $\Delta H = -52.6 \pm 0.3$ and -19.8 ± 0.2 kcal per mole of H_2, respectively. The differential entropies of reaction are $\Delta S = -35.2 \pm 0.3$ and -30.1 ± 0.4 cal per mole $H_2 \cdot$deg, respectively. Relative partial molal and integral thermodynamic quantities were calculated in the system to the dihydride phase. (auth)

31374 THERMAL CONDUCTIVITY AND ELECTRICAL RESISTIVITY OF BERYLLIUM COPPER FOIL. Watson, T. W.; Flynn, D. R. (National Bureau of Standards, Washington, D. C.). Trans. Met. Soc. AIME, 242: 876-80(May 1968).

Measurements have been made of the thermal conductivity and electrical resistivity of two specimens of 2 mm-thick Be–Cu foil at –140 to +200°C. The thermal conductivity of Be–Cu Alloy 125 was found to be significantly higher than that of Alloy 25, which had a higher impurity content. The thermal conductivity and electrical resistivity values obtained were in concordance with the Smith and Palmer relation for copper alloys which states that $\lambda = 0.0239\ (T/\rho) + 0.075$ where λ is thermal conductivity (W $cm^{-1}\ deg^{-1}$), ρ is electrical resistivity (microhm-cm), and T is absolute temperature (°K), indicating that the Smith and Palmer relation can be used to predict the thermal conductivity of this type of Be–Cu alloy at –140 to +200°C to within an accuracy suitable for most engineering applications. (auth)

31375 LOW-TEMPERATURE ELECTRICAL PROPERTIES OF SOME TRANSITION METALS AND TRANSITION-METAL CARBIDES. Clinard, F. W. Jr.; Kempter, C. P. (Los Alamos Scientific Lab., N. Mex.). Contract W-7405-eng-36. J. Less-Common Metals, 15: 59-73(May 1968). (LA-DC-9256).

The specific electrical resistivities of seven transition metal carbides (zirconium carbide, hafnium carbide, niobium carbide, tantalum carbide, dimolybdenum carbide, ditungsten carbide, and tungsten carbide) and ten transition metals (scandium, yttrium, titanium, zirconium, hafnium, niobium, tantalum, chromium, molybdenum, and tungsten) were measured between 2 and 300°K. The data were fitted from 2°K, or higher for the superconducting materials, to the crossover temperature T_0 by the expression $g(T) = \rho_0 + \beta T^n$, and from T_0 to 300°K by the Bloch–Grüneisen function plus a constant. The latter expression represented the high-temperature data well, whereas the low-temperature expression represented most of the data fairly well. The parameters derived from these two expressions are discussed and compared. (auth)

31376 CASEHARDENING AT HIGH TEMPERATURE. Dumini, W.; Montevecchi, I. (Istituto di Ricerche Breda, Milan). Met. Ital., 60: 37-43(Jan. 1968). (In Italian).

Results of casehardening tests at 950 to 1025°C on standard types of UNI steel such as CIO, C15-16, MnCr5, and 18 NiCrMo5 are reported and the techniques and materials employed as components of the casehardening furnace are described. The results have shown that the casehardening at 1000 to 1025°C offers a great practical interest because, limiting the length of the treatment to one hour approximately, it is possible to obtain greater effective depths of casehardening than requested without degrading the mechanical characteristics of the material resulting from excessive increase of grain. The elimination of residual austenite in the structure of the casehardened sheet has however imposed additive hardening treatments, the forms of which are reported. (tr-auth)

31377 COMPARISON BETWEEN TWO TYPES OF HEAT TREATMENT FOR STEEL TO BE USED AT HIGH TEMPERATURE WITH REGARD TO MASS EFFECT. Myallonnier, A. Met. Ital., 60: 15-22(Jan. 1968). (In Italian).

A comparative examination is made of normalizing-tempering and isothermal annealing heat-treatments, with particular reference to mass effect in forgings made of UNI type 5462-64 Steel (12% Cr, 9 to 10% Mo). It was found that in the normalizing-tempering treatment, substantial changes in structure and mechanical properties are caused by size alterations, changes also noticeable when test pieces are drawn from different locations in the forged part. In the isothermal-annealing treatment, variations in structure and mechanical properties are markedly reduced, showing that steel is affected by mass effect to a considerably lower degree; structure mainly consists of ferrite-pearlite grains and mechanical strength is lower as compared with the other treatment for this type of steel. Creep values are higher. (tr-auth)

31378 CONSIDERATIONS ABOUT THE INFLUENCE OF THE TEMPERATURE OF THE FIRST TEMPERING ON TEMPER BRITTLENESS: INFLUENCE OF LEAD. Nicodemi, W.; Zoja, R.; Masi, A.; Ravizza, P. Met. Ital., 60: 5-14(Jan. 1968). (In Italian).

The influence of the first tempering temperature on the movement of transition curves of 35 CrMn5 and 38 NiCrMo4 steels is examined. The effects of lead, added to improve the workability of these types of steels, on tools are also examined. It is shown that when the temperature of the first tempering increases, the transition temperature (considered as the beginning of the brittle fracture) lowers uniformly. The presence of lead does not raise the temperature of the beginning of the brittle fracture, on the contrary, in 38 NiCrMo4 steel there is a light movement of the transition curves towards lower temperatures. (tr-auth)

31379 MAGNESIUM ALLOYS FOR CANS AND PLUGS OF FUEL ELEMENTS FOR THE GRAPHITE-GAS DIE. INFLUENCE OF VARIOUS FACTORS ON THE MECHANICAL PROPERTIES AT OPERATING TEMPERATURES. Andre, J.-P.; Dabosi, F.; Le Bret, P. (CEN, Saclay, France). Mem. Sci. Rev. Met., 65: 27-41(Jan. 1968). (In French).

These alloys must have good ductility under heat and satisfactory creep strength. A study was made of the influence of a heat treatment prior to the mechanical test, of alloy composition (especially Zr and Mn), and of the testing conditions. (auth)

31380 MEASUREMENT OF MODULUS OF DISPLACEMENT OF TUNGSTEN AT HIGH TEMPERATURE IN A WIDE FREQUENCY RANGE. Shestopal, V. O.; Shestopal, O. Ya. Fiz. Metal. Metalloved., 25: 133-9(Jan. 1968). (In Russian).

By the method of forced torsion oscillation in the frequency range from 0.01 to 20 Hz, the comparative displacement modulus of W VA-3 at 1000 to 2500°K and of polycrystalline W zone purified at 900 to 2300°K was measured. By the static load method, an approximate evaluation was made of the comparative displacement modulus of the zone-purified W in the range from 0.0004 to 0.04 Hz. (tr-auth)

31381 CONTINUOUS COMPILATION OF NEW REFERENCE DATA ON DIFFUSION PROCESSES IN INORGANIC SOLIDS AND THEIR MELTS. VOLUME 1, NUMBER 1. Diffus. Data, 1: No. 1, 1-100(May 1967).

A compilation of new reference data for diffusion in inorganic solids and their melts is presented. The temperature and concentration ranges over which the new data are applicable are given. The experimental methods by which the data were obtained are stated briefly. The tabulated data are arranged in the following groupings: diffusion in solid metals, alloys, and intermetallic compounds; diffusion in liquid metals and alloys; diffusion in simple oxide systems; diffusion in complex oxide mixtures, glasses, slags, silicates, and titanates; diffusion in minerals; diffusion in halides; diffusion in nitrates; and diffusion in miscellaneous compounds. (168 references.) (B.L.M.)

Structure and Phase Studies

Refer also to abstracts 30755, 30894, and 31355.

31382 (ANL-Trans-601) RADIOGRAPHIC INVESTIGATION OF THE $\alpha \rightleftharpoons \beta$-TRANSFORMATION OF PURE URANIUM. Eisenblaetter, J.; Haase, G.; Granzer, F. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from J. Nucl. Mater., 21: 53-60(1967). 16p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

This paper was abstracted from the original language and appeared in NSA as 21: 4974. (R.C.K.)

31383 PHASE EQUILIBRIA IN THE SEPTEMS U–UMn_2–UFe_2 AND UAl_2–UMn_2–UFe_2. Petzow, G.; Sampaio, A. O.; De Lourdes Pinto, M. (Max-Planck-Institut fuer Metallforschung, Stuttgart. Laboratorio de Fisica e Engenharia Nucleares, Sacavem, Portugal). J. Nucl. Mater., 26: 331-7(1968). (In German).

Constitution of the systems, established by thermal, x-ray, and metallographic methods, is described by the surfaces of incipient melting, isothermal, and vertical sections. The system U–UMn_2–UFe_2 exhibits an invariant equilibrium, $\gamma + U_6(Mn,Fe) = S + \beta$ at 750°C. Complete solubility exists between the intermetallic phases U_6Fe and U_6Mn, as well as UFe_2 and UMn_2. Therefore, the two-phase zones α-U + $U_6(Mn,Fe)$ and $U_6(Mn,Fe)$ + $U(Mn,Fe)_2$ dominate almost the entire system at room temperature. In the system UAl_2–UMn_2–UFe_2 complete solid solubility exists between the two ternary phases $U(Fe,Al)_2$ and $U(Mn,Al)_2$. (auth)

31384 THE RECRYSTALLISATION OF β-QUENCHED URANIUM CONTAINING IRON AND ALUMINIUM. Smith, A. F. (Central Electricity Generating Board, Berkeley, Eng.). J. Nucl. Mater., 26: 341-4(1968).

Sections from standard β-quenched uranium bars (with 250 ppM Fe and 700 ppM Al) were annealed for various times at 590 to 655°C and the recrystallization process followed, using metallographic and x-ray techniques. These studies showed a relatively higher strained outer rim due to quenching and machining stresses Recrystallization was preferentially initiated in this outer region and proceeded inward; the driving force was derived from strain energy. (M.C.G.)

31385 PHASE STUDY OF URANIUM–PLUTONIUM–ZIRCONIUM ALLOYS. Tucker, P. A.; Etter, D. E.; Gebhart, J. M. (Mound Lab., Miamisburg, Ohio). Trans. Amer. Nucl. Soc., 11: 99(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31386 SINTERING IN THE PRESENCE OF A LIQUID PHASE. Whalen, T. J.; Humenik, M. Jr. (Ford Motor Co., Dearborn, Mich.). pp 715-46 of Sintering and Related Phenomena. Proceedings of the International Conference, Univ. of Notre Dame. Kuczynski, G. C.; Hooton, N. A.; Gibbon, C. F. (eds.). New York, Gordon and Breach, Science Publishers, 1967.

See CONF-650644.

Liquid phase sintering has been shown to be a complex procedure during which several possible rate-determining processes may occur. The importance of wetting of the solid by the liquid has been discussed and processes for lowering the most important interface energy, that of the solid-liquid interface, were presented. The initial stage of sintering, the rearrangement stage, appears to occur in most systems and the extent of rearrangement depends on the amount of liquid present, the solubility of the solid in the liquid, and the wettability. The second stage, solution and reprecipitation, depends on the amount of liquid, the solubility and, particularly, on the value of the dihedral angle. The final stage, coalescence and subsequent grain growth will take place only if the dihedral angle is positive. Negligible grain growth takes place in a completely dispersed system in practical sintering times. More isothermal shrinkage and grain growth data are required to better characterize liquid phase sintering in the more complex ceramic systems. (auth)

31387 ROLE OF PLASTIC DEFORMATION IN CONVENTIONAL SINTERING AND HOT PRESSING. Lenel, F. V.; Ansell, G. S. (Rensselaer Polytechnic Inst., Troy, N. Y.). pp 351-62 of Sintering and Related Phenomena. Proceedings of the International Conference, Univ. of Notre Dame. Kuczynski, G. C.; Hooton, N. A.; Gibbon, C. F. (eds.). New York, Gordon and Breach, Science Publishers, 1967.

See CONF-650644.

It is postulated that the mechanism of material transport in both conventional sintering and in hot pressing at high temperatures is determined by the magnitude of stress exerted regardless of the type of driving force which causes transport, due to surface tension or to an external force. For fcc metals at low stresses, generally below 10^6 dynes/cm^2 (15 psi) the mechanism is one of Nabarro–Herring microcreep in which lattice vacancies migrate from boundaries under tensile stress to those under compressive stress. At higher stresses, generally above 10^7 dynes/cm^2 (150 psi) the mechanism is one of dislocation motion controlled by dislocation climb. The postulate for material transport is supported by the model experiments on sintering a silver sphere to a silver plate. Previous calculations and arguments are not in accord with the postulate. The reasons for the discrepancies in the conclusions reached are shown. (auth)

31388 PLASTIC FLOW VERSUS DIFFUSION IN THE SINTERING OF CRYSTALLINE SOLIDS. Seigle, L. L.; Brett, J. (General Telephone and Electronics Labs., Inc., Bayside, N. Y.). pp 273-99 of Sintering and Related Phenomena. Proceedings of the International Conference, Univ. of Notre Dame. Kuczynski, G. C.; Hooton, N. A.; Gibbon, C. F. (eds.). New York, Gordon and Breach, Science Publishers, 1967.

See CONF-650644.

The question of the importance of plastic flow versus diffusion in the sintering of crystalline solids, particularly metals, is discussed. The basic difference between the flow and diffusional mechanisms of sintering is defined, and the most critical experimental evidence is reviewed. There can be little doubt that diffusional processes play a major role in the sintering of crystalline non-metals as well as metals. The action of plastic flow during the sintering of crystalline solids has not been unequivocally demonstrated; nevertheless, there is reason to suspect that flow processes may play a role in the early stages of interparticle bonding. (auth)

31389 METHOD OF DETERMINING THE WAGNER INTERACTION PARAMETERS USING THE TORSION-EFFUSION TECHNIQUE: APPLICATION TO THE Ag–Zn–Sn SYSTEM. Desre, P. (Centre National de la Recherche Scientifique, Grenoble, France). pp 67-74 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968. (In French).

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

By combining vapor pressure measurements obtained using the Knudsen effusion and the torsion-effusion methods above dilute solutions, the activity coefficients and Wagner interaction parameters in ternary systems can be determined directly. The torsion-effusion method consists in letting vapor from the volatile element of a solution effuse through two orifices made in a crucible on either side of a torsion wire by which the system is suspended. The partial pressure of the volatile element A of a liquid ternary mixture (A, B, M), where M is a solvent, is proportional to the torsion angle ϕ, the proportionality factor K′ being the Searcy constant. By measuring the torsion angle as a function of time, it is possible to calculate the activity coefficient of A. In addition, since the solution is diluted in A and B, the torsion angle varies exponentially as a function of time and the interaction coefficient $\epsilon^{B}_{A(M)}$ can be obtained. Applied to the system (Ag–Zn–Sn) (tin as solvent) at 774°K ($\epsilon^{Zn}_{Ag(Sn)} = +2.1 \pm 0.1$), this method offers the advantage of direct determination of the interaction coefficient without introducing either the vapor pressure above the pure metal or the Knudsen or Searcy constants. (auth)

31390 STUDIES ON FUSED SALT-METALLIC SODIUM TWO-PHASED SYSTEMS AS A PRELIMINARY TO THE OPERATION OF A FUSED-SALT POLAROGRAPH. Rowlands, D. L. G.; Wilson, J. D.; McInnes, C. A. J.; Watson, P. G. (Atomic Energy Research Establishment, Harwell, Eng.). pp 181-93 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

The Prototype Fast Reactor utilizes molten Na as a coolant. It is known that corrosion of 18/8/1 stainless-steel container material results in part from the production of various O containing Na compounds. The major part of the impurity is removed by cold trapping at 120°C. However, an alternative is a hot trap gettering procedure using Zr or Ti as the getter. To monitor the level of O impurity a continuous reading in-line apparatus is advantageous. One possibility is a polarograph consisting of a fused salt mixture as the electrolyte and a rising sodium drop as one electrode. This instrument should have the capability of measurement in the 1 to 10 ppM range of impurity. As a preliminary to the design and construction of the fused salt polarograph it is necessary to investigate if the electrolyte is compatible with molten Na up to the required temperatures. Both components are heated up to 540°C for periods of 1 to 12 hours, the reaction chilled rapidly, and the metal and salt phases analyzed by volumetric and flame photometric methods. As anhydrous salt mixtures are required it is also necessary to control and measure their water content. Anhydrous hydrogen halide gas purification allied to strict glove box practice is employed to achieve and maintain a minimum water content. To detect the presence of water, its reaction with Na in liquid ammonia, catalyzed by $Cu(NH_3)_4(NO_3)_2$, forms the basis of measurement. (auth)

31391 REPRESENTATION OF THERMODYNAMIC MIXING DATA OF METALLIC BINARY SYSTEMS: USE OF THE "SURROUNDED ATOM" MODEL. Hicter, P.; Mathieu, J. C.; Durand, F.; Bonnier, E. (Centre National de la Recherche Scientifique, Grenoble, France). pp. 699-714 of Thermodynamics of Nuclear

Materials, 1967. Vienna, International Atomic Energy Agency, 1968. (In French).

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

The automatic treatment of thermochemical equilibria in condensed phases requires an analytical knowledge of the thermodynamic mixing quantities as a function of the concentration. Designed as a particularly flexible interpolation and extrapolation method, permitting differentiation and integration, the surrounded atom model represents a possible solution of this problem. By quasi-chemical treatment of a group of atoms with potential energies and vibration energies, differing in accordance with the immediate environment, the model leads to the formulation of the various thermodynamic mixing quantities on the basis of four adjustable parameters: two for the mixing enthalpy and two for the excess vibration entropy. (auth)

31392 THERMODYNAMIC CHARACTERISTICS OF GRAIN GROWTH IN α-URANIUM. Cerovic, D.; Ristic, M. M. (Boris Kidrich Nuclear Inst., Belgrade). pp. 727-33 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

Taking into account the thermodynamic formulations of the theory of absolute reaction rates and experimental results, the thermodynamic characteristics of the activation of grain growth in alpha U were calculated. The results were compared with the corresponding self-diffusion characteristics in alpha U. An estimation of the change in the basic thermodynamic parameters in grain growth of alpha U was made. The free energy of activation increases linearly with temperature in the interval 450 to 600°C, its temperature coefficient being 17.3 cal/mole °K and its mean value for the given interval 107,750 cal/mole. Change in free energy of grain growth shows linear increase with temperature. The mean value for the given interval is $+3.5 \times 10^{-1}$ cal/mole. The entropy of the system decreases with grain growth. Its change for the given material is -3.2×10^{-4} cal/mole °K. The enthalpy of the system increases with grain growth. Its change for the given material is 9.3×10^{-2} cal/mole. (auth)

31393 REPRESENTATION OF THERMODYNAMIC MIXING DATA IN THE METALLIC BINARY SYSTEMS. Ansara, I.; Bonnier, E. (Centre National de la Recherche Scinetifique, Grenoble, France). pp 715-25 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968. (In French).

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

The values of the thermodynamic mixing functions obtained from experimental measurements involve some uncertainty due to systematic and aleatory errors accumulated during the experiment. These values are therefore generally coupled with a dispersion which could only be reduced by increased precision. The results relating to the thermodynamic mixing quantities are usually in the form of a discrete sequence of values. It is sometimes essential to represent these quantities by functions which correctly reflect the phenomenon. However, the theoretical formulation relative to these quantities at the present moment only applies for families of alloys. The maximum possible number of metallic systems can be treated by starting with a representation using the least squares method on polynomials which have a flexible character as long as the degree is not too high. However, if the curves calculated involve changes of curvature owing to aberrant points or to the excessive dispersion of the points, a smoothing formula is used which, while taking into account all the experimental points, makes it possible to minimize divergencies and to obtain a smooth curve, i.e., without abrupt changes of curvature. The formula utilized is that by Whittaker, extended to polynomials by Ritout. If the experimental data defy every kind of representation, a method involving the spline function can be used to obtain smooth curves and values, but it is particularly cumbersome to apply. (auth)

31394 BERYLLIUM-CALCIUM PHASE DIAGRAM. Potard, C.; Bienvenu, G.; Schaub, B. (CEN, Grenoble, France). pp 795-807 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968. (In French).

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

The Be–Ca phase diagram was established on the Be-rich side by a segregation method and by differential thermal analysis. The segregation method consists of decanting a solid phase (close to the composition of the definite compound $Be_{13}Ca$) in equilibrium at different temperatures between 1573 and 1923°K, with the surrounding liquid alloy. The system is then immersed and the non-decanted phase analyzed. The concentration is that of the liquidus at the temperature of the experiment. The thermodynamic equilibrium was studied by measuring the speed with which the equilibrium was obtained after a large temperature variation by an in situ liquid sampling method. Decantation was checked by an autoradiographic method. The decanted phase was identified by x-ray diffraction and point analysis using an electronic microprobe. The solid phase is assimilable to the definite compound $Be_{13}Ca$ at any temperature. The fusion temperatures of pure beryllium and the eutectic Be-$Be_{13}Ca$ were measured by differential thermal analysis. The solid transformation temperatures of the Be and the eutectic were also determined. Be fusion and transformation enthalpies were estimated by comparing the areas of the differential thermal analysis peaks with a direct measurement of the sum of these two enthalpies. The eutectic composition and the fusion temperature of the definite compound were determined by extrapolating the function $\varphi(X_{Ca})$, defined on the basis of the thermodynamic equilibrium of the two phases, at the eutectic temperature on the one hand and at the $Be_{13}Ca$ composition on the other. The phase diagram shows a slight Be–Ca interaction in the heavily diluted liquid, in accordance with recent measurements of the limiting activity coefficient of Ca in Be. (auth)

31395 STUDY OF THE DISTRIBUTION OF IRON, COPPER, AND MOLYBDENUM IMPURITIES BETWEEN THE SOLID AND LIQUID PHASES IN ALUMINIUM–BERYLLIUM ALLOYS. Potard, C.; Bienvenu, G.; Schaub, B. (CEN, Grenoble, France). pp 809-25 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968. (In French).

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

Studies on the purification of Be by extraction in a metallic solvent, in particular by liquation in Al–Be alloys, led to an investigation of the distribution of small quantities of Fe, Ca, and Mo between the solid and liquid phases as a function of temperature. By analyzing the liquid in equilibrium with the solid at different temperatures, the Be–Al liquidus was determined. The concentration of the impurity in question was in thermodynamic equilibrium with its solid solution in the crystallized Be presumed to contain no Al. The expression for the distribution coefficient involving the initial quantities and those measured in the liquid was derived on the assumption that diffusion of the impurity in question is zero in the crystallized Be and complete in the liquid. The distribution coefficient and its variation with temperature are used to calculate the thermodynamic quantities for transfer of the impurities from the liquid to the solid phase. The technique employed is based on sampling liquid in situ by pipetting and simultaneous filtration using narrow silica tubes. Chemical analyses are then carried out on the samples. A different technique using radioactive Cu was also employed. The preliminary equilibrium studies were carried out by observing the variation in concentration of the impurity as a function of time after disruption of an equilibrium state by a rapid lowering of temperature. The liquidus determined by this technique in an Al–Be alloy was found to be close to the liquidus given by Hansen. No characteristic change in the solubility of the Be due to the small additions of impurity was observed. (auth)

31396 THERMODYNAMIC ANALYSIS OF DOUBLE PHASE DIAGRAMS OF YTTRIUM IN ASSOCIATION WITH TRANSITION METALS OF THE IV–VI PERIODS. Al'tovskii, R. M.; Gornyi, D. S.; Lyutikov, R. A.; Panov, A. S. (Inst. of Energetic Physics, Obninsk, USSR). pp 735-44 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968. (In Russian).

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

Examination of published data on double phase diagrams of yttrium in association with transition metals of the IV–VI periods, reveals a number of regular features in the way types of diagrams changed according to the position of the elements in the periodic system. Yttrium shows the least affinity with transition metals of Group V (vanadium, niobium, tantalum), with which it does not mix in either solid or liquid form. During the transition both at the beginning and at the end of each period, the affinity of yttrium with the transition metals increases. With metals of Groups II-VIII, yttrium forms broad zones of solid solutions or stable intermetallic compounds. The regularities revealed can be explained by applying methods of statistical analysis to the phase diagrams in respect of a number of parameters (atomic radius, electronegativity, heat and entropy of fusion and evaporation, thermal capacity, etc.) and comparing stable electronic configurations of components in approximation of the theory of regular solutions. A forecast is made of the probable type of a number of hitherto unknown phage diagrams: yttrium-gold, yttrium-silver, yttrium-technetium, yttrium-ruthenium, yttrium-rhodium and yttrium-palladium. (auth)

31397 STRUCTURE DEVELOPMENT OF Mg–Zr (0.5 PERCENT Zr) AND Mg–Zr–Mn (0.5 PERCENT Zr AND 0.1 PERCENT Mn) ALLOYS DURING HEAT TREATMENTS IN THE PRESENCE OR ABSENCE OF WATER VAPOR TRACES. Pegoud, J. (Societe Industrielle de Combustibles Nucleaires, Veurey, France); Sifferlen, R.; Saulnier, A.; Dabosi, F. Mem. Sci. Rev. Met., 65: 43-58 (Jan. 1968). (In French).

Optical and electron microscope examination was carried out using thin specimens and replicas, chemical determination, and x-ray study. Demonstration was made of the very low mobility of zirconium in the solid solution. The effect of manganese is comparable to that of hydrogen. (auth)

31398 DYSPROSIUM–LEAD SYSTEM. McMasters, O. D.; O'Keefe, T. J.; Gschneidner, K. A. Jr. (Ames Lab., Iowa). Trans. Met. Soc. AIME, 242: 936-9(May 1968). (IS–1707).

X-ray diffraction, differential thermal, and metallographic methods were used to establish the Dy-Pb phase diagram. Lead additions lower the 1377°C transformation temperature of dysprosium to 1360°C leading to an inverted peritectic reaction. The 327°C melting point of lead is lowered by dysprosium additions to about 326°C yielding a eutectic reaction. A second eutectic reaction occurs at 13.3 at. % Pb and 1200°C. The dysprosium-richest intermetallic compound Dy_5Pb_3 melts congruently at 1695°C and crystallizes in the hexagonal Mn_5Si_3 ($D8_8$) type structure. The peritectic decomposition temperatures for the remaining compounds are Dy_5Pb_4 at 1555°C, $DyPb_2$ at 955°C, and $DyPb_3$ at 880°C. A fifth compound near the DyPb stoichiometry exists over a 310°C temperature range decomposing at 1130°C by means of an inverted peritectic reaction and melting incongruently at 1440°C. The crystal structures of the compounds are discussed. (auth)

31399 DETERMINATION OF DIFFUSION COEFFICIENTS IN POLYCRYSTALLINE MATERIALS BY MEANS OF β-EMITTING ISOTOPES. Gruzin, P. L.; Zharov, Yu. D.; Zemskii, S. V.; Kupalova, I. K. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Zavod. Lab., 34: 445-8(1968). (In Russian).

Volume coefficients and boundary diffusion parameters in polycrystalline materials were calculated using isotopes with soft β emission. Theoretical magnitudes $F(\eta,\epsilon)$ were obtained as functions of boundary diffusion rate and theoretical curves were constructed for diffusion coefficients at various magnitudes of the $a\theta$ parameter and the size of grain. (R.V.J.)

31400 INVESTIGATION OF THE VANADIUM–TECHNETIUM ALLOY SYSTEM. Koch, C. C.; Love, G. R. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. J. Less-Common Metals, 15: 43-58(May 1968). (ORNL–P–3601).

A phase diagram was determined for the vanadium–technetium alloy system using the following techniques: metallography, x-ray diffraction, electrical resistivity measurements, electron-probe microanalysis of a diffusion couple, microhardness measurements, and solidus point determinations. In addition to the terminal phases, three intermediate phases were observed in this alloy system. There is a phase centered about 50% Tc having the ordered bcc (CsCl-type) structure and two phases of higher technetium content, (δ and γ), which exist above 1150°C. The structures of these phases were not determined, but it is proposed that they are also related to a bcc lattice. Precise lattice parameter, electric resistivity, and microhardness data are presented. Eutectoid decomposition of the δ phase was examined by metallography and microhardness measurements. Implications of metallurgical variations on the superconducting properties of these alloys are discussed. (auth)

31401 ORDERING AND THE K STATE IN NICKEL–MOLYBDENUM ALLOYS. LeFevre, B. G. (Georgia Inst. of Tech., Atlanta); Guy, A. G.; Gould, R. W. Trans. Met. Soc. AIME, 242: 788-95(May 1968).

The resistivity anomaly known as the K state was studied in Ni–Mo alloys containing 10.5 and 14.0 at.% Mo. Both these alloys exhibit a large K effect which depends on the mechanical and thermal treatment. On the basis of X-ray diffuse scattering studies which were correlated with resistivity measurements, it appears that the K state in dilute Ni–Mo alloys can be associated with changes in the degree of short-range order within the α phase. (auth)

31402 PHASE EQUILIBRIA IN THE Mg–Nd–Mn–Ni SYSTEM. Drits, M. E.; Bochvar, N. R. (Inst. of Metallurgy, Moscow). Dokl. Akad. Nauk SSSR, 178: 403-5(Jan. 11, 1968). (In Russian).

A phase diagram was constructed for the system of Mg–Nd–Mn–Ni alloy with a constant content of 1.5% Mn, and 3% Nd annealed at 500, 400, and 250°C. The examined cross sections showed that additions of Ni into Mg–Mn–Nd alloys (with the phases α + Mn and α + Mg_9Nd) reduced Mg and Nd diffusion in solid solutions while Mg and Nd do not affect diffusion of Ni into quaternary solid solution. (R.V.J.)

31403 REVISION OF THE TITANIUM–TUNGSTEN SYSTEM. Rudy, E.; Windisch, St. (Aerojet-General Corp., Sacramento, Calif.). Trans. Met. Soc. AIME, 242: 953-4(May 1968).

A study was made to construct a new Ti–W phase diagram. The procedure for the preparation of the samples is outlined. For the investigation of the solid-state equilibria, the specimens were homogenized for 2 hr at slightly subsolidus temperatures and then reequilibrated at, and rapidly cooled from, the selected equilibrium temperatures. No phase discontinuity could be detected and analysis of alloys quenched at solidus temperatures revealed only a single phase. (J.C.W.)

31404 SPARK-MACHINE DAMAGE IN NIOBIUM SINGLE CRYSTALS AS INDICATED BY ETCH FIGURES. Guberman, H. D. (Oak Ridge National Lab., Tenn.). J. Appl. Phys., 39: 2975-6(May 1968).

The distribution of dislocations was studied in the vicinity of a spark-machined notch in Nb single crystals. A Servomet spark machine was used at its No. 4 and 6 spark settings. Optical microscopy showed dense dislocations adjacent to the cut surface at the root of the notch and zones of plastic deformation extending beyond the notch. Depths of damage were measured. It is suggested that the damage may be reduced by operating at lower spark energies. (D.L.C.)

31405 STRUCTURE OF ULTRATHIN FILMS PRODUCED BY VACUUM EVAPORATION OF TANTALUM AND IRIDIUM. Lainer, D. I.; Kholmyanskii, V. A. (State Scientific Research and Planning Inst. for Alloys and Fabrication of Light Metals, Moscow). Sov. Phys.-Cryst. (Engl. Transl.), 12: 913-18(May-June 1968).

Translated from Kristallografiya, 12: 1051-7(Nov.-Dec. 1967).

Deposition of tantalum and iridium was carried out on specially prepared substrates composed of quartz plates with previously deposited layers of carbon and SiO_2. The films produced were investigated by electron diffraction and electron microscopy. During condensation, tantalum oxidizes and forms films of TaO, which has a fcc lattice, while iridium films have the normal lattice of the bulk material. The crystal size was calculated from the broadening of the interference maxima, as a function of the substrate temperature and the average film thickness. (auth)

31406 SURFACE STRUCTURE OF NEGATIVE CRYSTALS (PORES) IN MOLYBDENUM. Klein, G. A.; Krakhmalev, V. A. Sov. Phys.-Cryst. (Engl. Transl.), 12: 964(May-June 1968).

Translated from Kristallografiya, 12: 1096-7(Nov.-Dec. 1967).

Electron microscopic studies of trans- and inter-crystalline replicas of pure and Zr-doped Mo revealed that the pores had a distinctive fine structure. In brittle transcrystalline fragments, this structure is in the form of a system of concentric steps around the point of emergence of the [001] direction. The pores of intermediate form had a mirror-symmetric surface structure of a set of poles, each surrounded by concentric polygonal steps. The pole size is greatest for the [001] directions. Small pores ($\leq 1\ \mu$) appear as polyhedra without fine structure. (D.L.C.)

31407 THE CRYSTAL STRUCTURE OF EKANITE $ThK(Ca,Na)_2Si_8O_{20}$. Mokeeva, V. I.; Golovastikov, N. I. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Dokl., Earth Sci. Sect. (Engl. Transl.), 167: 106-8(Mar.-Apr. 1966).

The crystal structure and formula of ekanite were determined, including a variant in which the position of K is vacant and Na replaced by Ca. The cell parameters are $\underline{a}$ = 7.58 Å, $\underline{c}$ = 14.82 Å. The x-ray diffraction patterns confirmed the tetragonal symmetry of ekanite. The absence of h0l and hhl reflections enable ekanite to be referred to one of 2 Fedorov groups, $D_{4h_2} = P4/mcc$, which was confirmed during interpretation of the structure. Projection of the Patterson function P(xy) was interpreted as having all its peaks fit the vectors between Th and the other atoms. The coordinates of Th, K, Ca–Na, Si, O_1, O_2, and O_3 in ekanite are tabulated. Chemical analysis revealed a deficit in the amount of K as compared to that required by the formula (8 atoms of Si are shared by ~0.8 K atoms). This was confirmed by the peak in the xy projection, showing a lower height of K as compared to that of Ca and Na. The postulated structural formula is diagrammed. (BBB)

31408 YIELDING, WORK HARDENING, AND CLEAVAGE IN TANTALUM–RHENIUM ALLOY SINGLE CRYSTALS. Raffo, P. L. (Lewis Research Center, Cleveland); Mitchell, T. E. Trans. Met. Soc. AIME, 242: 907-17(May 1968).

Single crystals of Ta–Re alloys have been deformed in tension and compression as a function of solute concentration and temperature. The temperature dependence of the yield stress is decreased by alloying. At low temperatures there is a minimum in the yield stress (at about 2 at. %) as a function of concentration. Three-stage hardening was not observed in the alloys. Linear hardening rates, where observed, were characteristic of stage II in pure tantalum. At low temperatures and high concentrations, work softening was often prominent at high strains. Electron microscopy revealed that dislocations are mostly of screw orientation, although heavily jogged and cusped, and often occurring in dipole pairs. The alloys become more prone to cleavage with increasing rhenium content, due mostly to an increasing yield stress rather than a change in cleavage strength. Alloying apparently decreases the Peierls stress of bcc metals at low temperatures by facilitating kink nucleation at solute atoms on screw dislocations. Higher solute concentrations further increase the yield stress. Quantitative calculations and comparisons with other bcc alloy systems are made to show that the predominant hardening mechanism is due to the interaction of dislocations with misfitting solute atoms close to their slip planes. The interaction is so localized that the core dilation of dislocations could be important. (auth)

31409 YTTRIUM–CARBON SYSTEM. Carlson, O. N.; Paulson, W. M. (Ames Lab., Iowa). Trans. Met. Soc. AIME, 242: 846-52(May 1968). (IS–1627).

A phase diagram is proposed for the Y–C system based on the results of thermal analyses, microscopic observations, and x-ray diffraction studies. Three intermediate phases occur in the system: a congruently melting fcc phase with a wide range of homogeneity about the composition Y_2C, an intermediate solid-solution region between 55 and 58 at.% C, and a bct dicarbide melting congruently at 2415°C. All three compounds undergo a phase transformation at elevated temperatures. A continuous series of solid solutions exists between the fcc phase and the high-temperature form of YC_2 with a maximum in the solidus at 2000°C and 30 at.% C and a minimum at 1805°C and 54 at.% C. (auth)

31410 YTTRIUM–TIN ALLOY SYSTEM. Schmidt, F. A.; McMasters, O. D. (Ames Lab., Iowa). J. Less-Common Metals, 15: 1-11(May 1968). (IS–1718).

A phase diagram is proposed for the yttrium–tin system based on thermal, microscopic, and x-ray evidence. Tin additions lower the transformation temperature of pure yttrium from 1465 to 1360°C by an inverse peritectic reaction while yttrium additions decrease the melting point of tin from 232 to 229°C by a eutectic reaction. There is also a eutectic at 11.5 at. % tin and 1260°C between yttrium and the compound Y_5Sn_3, which melts congruently at 1940°C. There are four additional compounds in the system, which result from peritectic reactions. The compositions of these compounds were determined to be Y_5Sn_4, $Y_{11}Sn_{10}$, YSn_2, and YSn_3. Horizontals associated with the decomposition of these compounds occur at 1790, 1600, 1140, and 515°C, respectively. (auth)

31411 FAZOVYE PREVRASHCHENIYA. (Phase Transformations). Svechinkov, V. N. (ed.). Respublikanskii Mezhvedomstvennyi Sbornik, Seriya Metallofizika. Kiev, Izdatel'stvo Naukova Dumka, 1967. 156p.

Phase transitions and phase equilibriums including polymorphic, and eutectoid transformations, disintegration of saturated solid solutions, and ordering, in metallic systems are discussed along with the influence of these transformations on the physical properties of metals and alloys. Discussions are included on x-ray scattering by aging alloys with modulated structure, kinetics of formation of austenite and reduction of grain in superheated steel, $\gamma \rightleftharpoons \alpha$ transformation and strengthening of iron–nickel alloys, and plastic deformations. Phase transformations in Co–Ta alloys and Fe–Ni–Al–Co alloys with low Co content are examined. Constitution diagrams and properties of Zr–Mo, Mo–Hf, and $W-Mo-Mo_2Hf-W_2Hf$ alloys, and the peculiarities of austenite transformations in magnesium pig iron are analyzed. Fourteen articles are included. (R.V.J.)

31412 THE FORMATION OF MARTENSITE IN U–10 AT. PERCENT Mo. Penney, J. Newcastle upon Tyne, Eng., International Research and Development Co. Ltd., 1968. 8p.

Studies are described on a U–10 at. % Mo alloy in which the α martensite formed on quenching from the γ phase has a monoclinic structure. A complex twin structure was evident, which consisted of two basic types of twin. Electron diffraction analysis showed that square and hexagonal symmetrical patterns were most common, comparing favorably with patterns reported for U–5% Mo (orthorhombic martensite). Thus no basic change could be detected in the structure of the orthorhombic and monoclinic α martensite in uranium rich U–Mo alloys. (auth) (UK)

Radiation Effects

Refer also to abstracts 30747, 32741, and 32812.

31413 (BNWL–532) IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS. Quarterly Progress Report, May–July 1967. Claudson, T. T. (ed.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Aug. 15, 1967. Contract AT(45-1)-1830. 241p. Dep. CFSTI.

Progress by the participating organizations and results of irradiation testing are reported in seven sections. A separate abstract was prepared for each section. (J.R.D.)

For abstracts of individual sections see: 31414–31419 and 32741.

31414 (BNWL–532, pp 12.1-88) IRRADIATION DAMAGE TO REACTOR METALS. Bement, A. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Tensile properties of Ni-based alloy Inconel-120 are presented after irradiation of 1.37×10^{21} n/cm^2 of fast neutrons. Tensile properties of AISI types 304 and 348 stainless steels are presented after irradiation at 290°C of 6.0×10^{21} n/cm^2 of fast neutrons. Effects of fast neutrons at 6.44×10^{21} n/cm^2 and at 290°C on tensile properties of AISI types 410 and AM 350 stainless steel are described. Results from tensile tests at 1350°F on Hastelloy-X-280 and Inconel-600 irradiated with fast neutrons at 1×10^{20} n/cm^2 are listed. Stress-rupture tests of Inconel-X-750 at 1350°F irradiated by fast neutrons of 1×10^{20} n/cm^2 are described. Mechanical properties of Zircaloy-2 are presented after controlled cold working. Radiation effects on AISI 304 and 348 stainless steels mechanical properties are described for flux of 1.7×10^{22} n/cm^2. The annealing damage induced by irradiating Mo at 600°C is described. Radiation effects on single-crystal Re rods are presented for fluxes of 2.5×10^{18} and 5×10^{18} n/cm^2. 58 references included. (auth)

31415 (BNWL–532, pp 4.1-5) EFFECTS OF IRRADIATION ON THE MECHANICAL PROPERTIES OF CLADDING MATERIALS. Kangilaski, M.; Wullaert, R. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Data on the radiation-induced mechanical property changes in AISI type 347 stainless steel are presented. The irradiation-induced embrittlement at elevated temperatures occurring in austenitic stainless steels and nickel alloys is described. Results of annealing the specimens are also presented. (auth)

31416 (BNWL–532, pp 7.1-18) IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS. Beeston, J. M.; Brinkman, C. R.; Zelezny, W. F. (Idaho Nuclear Corp., Idaho Falls).

Existing uncertainties as to the hydrogen embrittlement in high strength structural steels are reviewed. The residual hydrogen content of A302B, HY80, and A542 carbon steels is measured by extraction at 1200°C. A program to examine the fatigue behavior of fast reactor cladding steels, and structural steels in post irradiation tests is discussed. The fracture surface characteristics of the A350-LF3 steel PM-2A vessel are presented and analyzed. 21 references included. (auth)

31417 (BNWL–532, pp 9.1-23) RESEARCH PROGRESS. Hawthorne, J. R.; Serpan, C. Z. Jr.; Loss, F. J.; Potapovs, U.; Klier, E. P. (Naval Research Lab., Washington, D. C.).

Radiation embrittlement sensitivity of two A533, Grade B, Class 1 steel plates is measured at 550°F for neutron fluence of 2.3×10^{19} Charpy-V notch ductility properties in the strong and weak plate orientations of two quenched and tempered steels, 3½Ni–Cr–Mo and 5Ni–Cr–Mo–V, are compared after irradiation at 250°F. The effects of high neutron exposure on the impact and tensile properties of A353 (9% nickel) steel containing various amounts of retained austenite are described. The stress–strain responses of seven steels tested at 450 to 650°F are presented. Tensile properties of unirradiated A212-B and A302-B steel are also presented for 250 to 750°F. Susceptibility of A302-B steel to aging embrittlement is discussed. (auth)

31418 (BNWL–532, pp 10.1-26) EFFECT OF RADIATION ON REFRACTORY METALS AND HEAT RESISTANT ALLOYS. Moteff, J. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation).

Delayed creep phenomena of irradiated Mo in 3.1×10^{20} n/cm^2 tested at 700°C are analyzed after 1 hour of 700, 800, and 900°C anneals. The effect of irradiation temperature on the creep-rupture properties of W at 1100°C is determined. Short-time tensile and creep-rupture properties of 15Cr–4Al–Fe–1Y alloy at 705°C show some increase in uniform tensile elongation and decrease total elongation. 35 references included. (auth)

31419 (BNWL–532, pp 11.1-43) RADIATION METALLURGY. Billington, D. S.; Wechsler, M. S.; Stanley, J. T. (Oak Ridge National Lab., Tenn.).

The radiation embrittlement of weld heat-affected-zone (HAZ) samples and base plate samples of ASTM A-212B pressure vessel steel is described as a function of radiation dose and temperature. Tensile tests, electrical resistivity measurements, and internal friction measurements are presented for unirradiated and irradiated vacuum-melted Fe with and without 20 wt ppM of nitrogen. The temperature dependence of the yield stress in single crystal Nb is unchanged by neutron irradiation. The stress dependence of dislocation velocity was measured directly by etching techniques for unirradiated Nb as a function of temperature and number of zone passes and for irradiated single-zone-pass Nb at room temperature. 95 references included. (auth)

31420 (ORNL–4246) RADIATION METALLURGY SECTION, SOLID STATE DIVISION PROGRESS REPORT FOR PERIOD ENDING JANUARY 1968. (Oak Ridge National Lab., Tenn.). Apr. 1968. Contract W-7405-eng-26. 116p. Dep. CFSTI.

Investigations into radiation damage, hardening, and embrittlement of bcc metals are being conducted. Work on pressure vessel steels, niobium, and vanadium is reported. A separate abstract was prepared for each of the 13 sections. (D.L.C.)

For abstracts of individual sections see: 31334, 31345, 31346, and 31421–31430.

31421 (ORNL–4246, pp 1-6) RADIATION METALLURGY. Billington, D. S.; Wechsler, M. S. (Oak Ridge National Lab., Tenn.).

A review of research objectives is presented. It is noted that the principal metals under investigation are pressure vessel steels, Fe, Fe alloys, Nb, and V. Most effort is being devoted to mechanisms of radiation embrittlement, and the annealing characteristics of irradiated steel. (J.R.D.)

31422 (ORNL–4246, pp 6-27) THE TEMPERATURE DEPENDENCE OF YIELDING IN AN IRRADIATED PRESSURE-VESSEL STEEL AND THE RELATIONSHIP BETWEEN RADIATION HARDENING AND EMBRITTLEMENT. Wechsler, M. S.; Hinkle, N. E.; Berggren, R. G.; Stelzman, W. J. (Oak Ridge National Lab., Tenn.).

Tensile and impact tests were performed as a function of temperature on unirradiated and irradiated (10^{19} n/cm^2, >1 MeV) ASTM A-212-B steel. An attempt is made to correlate the ductile-brittle transition temperature with the intersection of the yield curve and the critical cleavage stress. The results show that the fracture stress is increased slightly by the irradiation and the triaxiality degree in the Charpy test at initiation of cleavage decreased slightly. (D.L.C.)

31423 (ORNL–4246, pp 27-30) POST-IRRADIATION ANNEALING OF ASTM A-212-B STEEL. Berggren, R. G.; Stelzman, W. J.; Jones, T. N.; Wechsler, M. S. (Oak Ridge National Lab., Tenn.).

Tensile tests were conducted after annealing at 250 to 400°C of A-212-B steel irradiated with 10^{19} n/cm^2 (E > 1 MeV). Recovery of lower yield stress is shown, and the shape of the stress-strain curves (upper yield point) is discussed. Results are interpreted to involve rearrangement of trapped interstitials. (D.L.C.)

31424 (ORNL–4246, pp 30-5) STRAIN AGING OF NEUTRON IRRADIATED STEEL. Stelzman, W. J.; Berggren, R. G.; Stanley, J. T. (Oak Ridge National Lab., Tenn.).

A strain-aging study was made of the behavior of interstitial C or N in irradiated (8×10^{18} n/cm^2, >1 MeV) ASTM A-212-B steel. Load-elongation curves show that irradiation reduces the strain aging effect. The strain aging is also plotted versus aging temperature. Results indicate trapping of N interstitials at radioinduced defects. (D.L.C.)

31425 (ORNL–4246, pp 36-7) EFFECT OF THERMAL NEUTRONS ON THE TENSILE PROPERTIES OF ASTM A-212-B AND A-302-B STEELS. Berggren, R. G.; Stelzman, W. J.; Wechsler, M. S. (Oak Ridge National Lab., Tenn.).

Tensile tests were conducted on specimens of the two steels irradiated (5×10^{18} n/cm^2, >1 MeV) with and without 0.040 inches cadmium shielding. No significant effect of the shielding on yields, ultimate strength, fracture strength, and elongation was found. (D.L.C.)

31426 (ORNL–4246, pp 42-51) INTERACTION BETWEEN OXYGEN AND RADIATION-PRODUCED DEFECTS IN NIOBIUM. Stanley, J. T.; Williams, J. M.; Brundage, W. E. (Oak Ridge National Lab., Tenn.).

Internal friction–temperature measurements were carried out on the trapping of interstitial O at dislocation loops in Nb irradiated with 2×10^{18} n/cm^2 (>1 MeV). The effects of annealing on the 150°C internal friction peak were determined. Annealing above 250°C returns the trapped O to solution. (D.L.C.)

31427 (ORNL–4246, pp 51-5) TRAPPING OF OXYGEN AND NITROGEN IN NEUTRON-IRRADIATED VANADIUM. Stanley, J. T.; Williams, J. M.; Brundage, W. E. (Oak Ridge National Lab., Tenn.).

Vanadium was irradiated to 7.2×10^{17} n/cm^2 (>1 MeV), and the decrease of the O and N internal friction peaks was measured as a function of time at the peak temperatures. The results indicate trapping of O and N at temperatures between 150 and 300°C. Isochronal annealing of the resistivity shows a large annealing stage centered at 180°C. (D.L.C.)

31428 (ORNL–4246, pp 55-66) ANNEALING CHARACTERISTICS OF NEUTRON IRRADIATED NIOBIUM. Ohr, S. M.; Tucker, R. P.; Bolling, E. D. (Oak Ridge National Lab., Tenn.).

The annealing characteristics were studied using tensile tests (lower yield stress) and electron microscopy (size distribution of defects). Irradiations were carried out to 2×10^{18} n/cm^2 (>1 MeV) and 2-hour anneals performed at 200 to 800°C. The observed radiation-anneal hardening is attributed to trapped interstitial C. (D.L.C.)

31429 (ORNL–4246, pp 66-75) FLUENCE DEPENDENCE OF RADIATION HARDENING IN POLYCRYSTALLINE NIOBIUM. Wechsler, M. S.; Tucker, R. P.; Ohr, S. M. (Oak Ridge National Lab., Tenn.).

Radiation hardening was measured in Nb irradiated with from 7×10^{16} to 4×10^{18} n/cm^2 (>1 MeV). A plot of the increase in yield stress vs square root of flux shows two straight-line portions, with the less-steep portion occurring at the higher fluxes. Possible explanations for this saturation effect are discussed. (D.L.C.)

31430 (ORNL–4246, pp 75-83) DEFORMATION OF IRRADIATED AND UNIRRADIATED Nb SINGLE CRYSTALS IN COMPRESSION. Guberman, H. D.; Reed, R. E. (Oak Ridge National Lab., Tenn.).

High-purity Nb single crystals were tested (flow stress and ultimate yield strength) at 194, 298, and 525°K before and after irradiation with 1.1×10^{17} and 8.3×10^{17} n/cm^2 (>1 MeV). The results show a temperature dependence of the yield stress which is somewhat affected by the irradiation. The athermal and thermal components of the resolved shear stresses are discussed. Activation volume measurements were also made, and activation volume vs shear strain curves are given. (D.L.C.)

31431 PHENOMENOLOGICAL STUDY OF RADIATION-EFFECTS DATA USING MULTIPLE REGRESSION ANALYSIS TECHNIQUES. Markworth, Alan J.; Eggers, Philip E. (Battelle Memorial Inst., Columbus, Ohio). Trans. Amer. Nucl. Soc., 11: 154(June 1968).

From 14th Annual Meeting of the American Nuclear Society Toronto. See CONF-680601.

31432 CORRELATION OF HOT HARDNESS WITH THE HOT, ULTIMATE TENSILE STRENGTH OF IRRADIATED AND UNIRRADIATED Nb AND Nb–1Zr. Kamphouse, J. L.; Moteff, J. (General Electric Co., Cincinnati). Trans. Amer. Nucl. Soc., 11: 151(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31433 RADIATION EFFECTS ON THE MICROSTRUCTURE OF TUNGSTEN. Rau, Robert C.; Moteff, John; Ladd, Robert L. (General Electric Co., Cincinnati). Trans. Amer. Nucl. Soc., 11: 152(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31434 EFFECT OF IRRADIATION ON THE MECHANICAL PROPERTIES OF ALUMINUM ALLOYS. King, R. T.; Weir, J. R. Jr. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 146-7(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31435 RADIATION EMBRITTLEMENT OF 12 Ni–5Cr–3Mo MARAGING STEEL AND COMPANION WELD METAL AT <250°F AND AT ELEVATED TEMPERATURES. Gray, Robert A. Jr.; Hawthorne, J. Russell (Naval Research Lab., Washington, D. C.). Trans. Amer. Nucl. Soc., 11: 147-8(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31436 RADIATION EFFECTS ON FIRST- AND SECOND-STAGE CREEP OF INCOLOY-800. Moteff, J.; Edwards, J. A.; Smith, J. P. (General Electric Co., Cincinnati). Trans. Amer. Nucl. Soc., 11: 148-9(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31437 EFFECT OF FAST-NEUTRON IRRADIATION ON THE MECHANICAL PROPERTIES OF SOME AUSTENITIC STAINLESS

STEELS. Comprelli, F. A.; Withop, A.; Lauritzen, T. A.; Busboom, H. J. (General Electric Co., Sunnyvale, Calif.). Trans. Amer. Nucl. Soc., 11: 145-6(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31438 DIFFUSE SCATTERING OF X RAYS BY GAMMA-IRRADIATED METALS. Malinenko, I. A.; Shivrin, O. N. (Petrozavodsk State Univ., USSR). Sov. Phys.-Cryst. (Engl. Transl.), 12: 958-60(May-June 1968).

Translated from Kristallografiya, 12: 1091-3(Nov.-Dec. 1967).

The effect of cobalt-60 gamma rays on the diffuse scattering of x rays is studied for annealed specimens of monolithic Mo, powdered Mo, and powdered Zn. The angular range $2\theta = 10$ to 150° is covered. The diffuse background level of monolithic Mo is higher by ~20% over the entire range after irradiation, and a diffuse intensity peak appears at $2\theta = 26°$, which is not changed by electropolishing. For powdered Mo, a smaller peak at $2\theta = 26°$ also appears upon irradiation, but the diffuse background is not changed. For powdered Zn, a regular increase in diffuse scattering intensity results from the irradiation. Interpretation of the results is discussed. (D.L.C.)

31439 EFFECT OF ELECTRON AND γ-RAY BOMBARDMENT ON THE MICROHARDNESS OF GERMANIUM. Khainovskaya, V. V.; Edel'man, F. L.; Smirnov, L. S. (Inst. of Semiconductor Physics, Novosibirsk, USSR). Sov. Phys.-Cryst. (Engl. Transl.), 12: 950(May-June 1968).

Translated from Kristallografiya, 12: 1085-6(Nov.-Dec. 1967).

p-Type Ge was irradiated with 5- to 7-MeV electrons and 1.25-MeV γ-rays to a total flux of 10^{16} cm^{-2}. The microhardness was increased 30 to 40% by this flux, but was not affected by Cd ions (20 keV, 2×10^{15} cm^{-2}). Annealing at 350°C restores the microhardness; two annealing stages were found, at 50 and 300°C. (D.L.C.)

31440 PROTON AND ULTRAVIOLET RADIATION EFFECTS ON SOLAR MIRROR REFLECTIVE SURFACES. Gillette, Roger B. (Boeing Co., Seattle). J. Spacecraft Rockets, 5: 454-60(Apr. 1968).

The effects of proton and ultraviolet radiation on the specular and diffuse reflectance of stretch-formed aluminum and electroformed nickel mirrors were studied. The stretch-formed aluminum mirrors were coated with films of SiO, Al, and in some cases Si_2O_3. The electroformed nickel mirrors were coated with films of Cr, SiO, Al, and in some cases Si_2O_3. Thus, the reflectance of both bare and Si_2O_3 protected aluminum was studied. Specular and diffuse reflectances were measured over the wavelength region from 0.295 to 2.5μ and specular solar reflectances were calculated. Proton and ultraviolet radiation experiments were conducted in high vacuum to determine effects on the mirrors at temperatures of –195 to 200°C. Test samples were irradiated with proton integrated fluxes in the range of 1×10^{15} to 2×10^{17} protons-cm^{-2}, and ultraviolet exposures up to 9700 equivalent space sun hours. The most severe mechanism of degradation is blistering. In the absence of blistering the optical degradation produced by either protons or ultraviolet radiation is not strongly temperature-dependent. Silicon-oxide surfaces were made smoother by the proton bombardment. On stretch-formed aluminum mirrors, severe reticulation of the reflective surfaces occurred at temperatures above 80°C. (auth)

31441 STEELS WITH LOW SENSITIVITY TO NEUTRON RADIATION: A SAFETY FACTOR. Sebille, J. (EURATOM, Brussels). pp 147-69 of Recurring Inspection of Nuclear Reactor Steel Pressure Vessels. Vienna, International Atomic Energy Agency, 1968.

From Conference of Experts on Recurring Inspection of Nuclear Reactor Pressure Vessels, Pilsen, Czechoslovakia. See STI/DOC–10/81; CONF-661047.

The metallurgical parameters affecting radiation damage such as ferritic grain-size, microstructure, composition, fabrication methods and melting practice, previous temper embrittlement, and strain-aging, are reviewed. Conclusions are drawn as to the relative importance of these parameters. The phenomenon of recovery of impact properties through annealing (defect annealing) is also considered. Possible ways of reducing radiation damage by altering metallurgical variables are analyzed on the basis of experimental results and theoretical considerations. In conclusion, the nature of additional research needed to solve the problem is indicated. (auth)

Ceramics and Cermets

Refer also to abstract 30756.

Preparation and Fabrication

Refer also to abstracts 31339 and 32815.

31442 FABRICATION OF CERAMIC COMPONENTS FOR USE IN PLUTONIUM ELECTROREFINING. Stoddard, S. D.; Nuckolls, D. E. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc., 11: 157-8(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31443 FLAME REACTOR PREPARATION OF FISSIONABLE OXIDE POWDERS. Federer, J. I.; Robinson, W. C. Jr.; Pratt, R. B. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 130(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31444 PREPARATION OF PROMETHIUM SESQUIOXIDE MICROSPHERES BY THE SOL-GEL PROCESS. Ambrose, C. J.; Andelin, R. L. (McDonnell Douglas Corp., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 156-7(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31445 MECHANISMS OF DENSIFICATION DURING HOT PRESSING. Coble, R. L. (Massachusetts Inst. of Tech., Cambridge). pp 329-50 of Sintering and Related Phenomena. Proceedings of the International Conference, Univ. of Notre Dame. Kuczynski, G. C.; Hooton, N. A.; Gibbon, C. F. (eds.). New York, Gordon and Breach, Science Publishers, 1967.

See CONF-650644.

The driving force for densification during hot-pressing is complex, both surface tension and the applied pressure have to be considered fully to describe the total motivating potential for densification when the applied pressure is moderate and the particle size is small. It appears likely that a multiplicity of material transport mechanisms will be operative in nearly all materials to be hot-pressed. Boundary sliding and particle fracture will occur during the initial stage of the process. A small amount of plastic flow is certain to occur in all materials. If the yield stress is small and the pressure is high, near completion of densification could occur by plastic flow. If the yield stress is moderate and the pressure is low the final stage of the process will probably occur by lattice or boundary diffusion. Models for densification rate based on either plastic flow or diffusional mechanisms can be adapted using phenomenological flow behaviors observed in dense materials. Thus Sherby's generalized formulation for dislocation climb controlled plastic flow, or Herring's diffusion controlled creep may be used to predict densification by employing alterations for the internal stress as a function of porosity, and including the surface energy as part of the driving force. For most materials in which hot-pressing studies have been conducted, there are, in general, inadequate data on simultaneous measurements of density and grain size as a function of time, temperature and applied pressure to critically evaluate the mechanisms of material transport during the process. For aluminum oxide the mechanism of densification appears to be lattice diffusion. Fair agreement exists between the calculated lattice diffusion coefficients from data on hot-pressing and those directly measured in alumina. In other soft materials such as lead, copper, and nickel oxide, a considerable portion of the densification probably occurs by plastic deformation. (auth)

31446 DIFFUSION CONTROLLED SINTERING IN OXIDES. Jorgensen, Paul J. (General Electric Research Lab., Schenectady, N. Y.). pp 401-22 of Sintering and Related Phenomena. Proceedings of the International Conference, Univ. of Notre Dame. Kuczynski, G. C.; Hooton, N. A.; Gibbon, C. F. (eds.). New York, Gordon and Breach, Science Publishers, 1967.

See CONF-650644.

The initial sintering kinetics of $Zr_{0.87}$, $Ca_{0.13}$, $O_{1.87}$, Cr_2O_3, and BeO have been examined. The kinetics follow diffusion sintering models. Directly measured cation and anion diffusion coefficients in these systems are compared with the diffusion coefficients calculated from the sintering kinetics, and excellent agreement is obtained. The sintering kinetics are controlled by volume diffusion of the slowest diffusing species. (auth)

31447 THE FREE ENERGY OF FORMATION OF NbO AND Ta_2O_5. Ignatowicz, S.; Davies, M. W. (British Steel Corp., London). J. Less-Common Metals, 15: 100-2(May 1968).

A galvanic cell method was used to measure the free energies of formation of NbO and Ta_2O_5. The values obtained were $\Delta G^0(\text{cal}) = -98{,}830 + 20.57T$ for NbO and $\Delta G^0(\text{cal}) = -480{,}100 + 97.65T$ for Ta_2O_3. (M.C.G.)

31448 MELTING POINT AND PHASE DIAGRAM DETERMINATION WITH A NEW PRECISION HIGH-TEMPERATURE MICROSCOPE TECHNIQUE. Stingele, A. (CCR-EURATOM, Petten, Netherlands). pp 9-24 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB–162; CONF-670915.

A new precision hot-stage for the study of equilibrium at solid-liquid interfaces was developed. The apparatus can be used up to 1400°C and permits a temperature constancy to within ~0.01°C. The temperature gradient within the sample was checked by direct and indirect methods and is smaller than 0.1°C. Linear heating and cooling rates from 0.05°C/min to 200°C/min can be selected. For the study of the equilibrium behavior at the liquidus line a thermal cycling program is available. Information is collected with an automatic movie camera control system. The apparatus was calibrated with the melting points of standard metals and some selected pure salts. The agreement with literature and our own thermal analysis data is excellent, therefore no corrections for the thermocouple output are required. The melting point of a substance depends on crystallographic features and impurity segregation at the solid-liquid interface. From thermodynamic considerations estimates of these effects can be made by referring to the measured first melting temperature. It is shown that the last melting temperature is an intrinsic property of the bulk of the material and representative for the melting point. Phase diagram determination is discussed generally, and specifically for the $NaCl-KCl$ and $Na_2CrO_4-K_2CrO_4$ systems. The advantages over conventional thermal analysis techniques are discussed briefly. (auth)

31449 PREPARATION PROCESSES AND STABILIZATION OF URANIUM MONOCARBIDE. Gorle, F.; Timmermans, W.; Casteels, F.; Vangeel, J.; Brabers, M. (Studiecentrum voor Kernenergie, Mol, Belg.). pp 481-96 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB–162; CONF-670915.

The reduction of hyperstoichiometric uranium carbide and stabilization of uranium monocarbide by metal addition are discussed. The reaction of hyperstoichiometric uranium carbide with different gases (pure hydrogen, H_2-Ar and H_2-CH_4 mixtures) was studied by measuring the CH_4 evolution using gas chromatography. The starting material was uranium carbide obtained from reaction at 1500°C of UO_{2+x} with graphite. Reaction of UC_2 with pure hydrogen starts at about 350°C and is very rapid at 600°C, the uranium carbide being reduced within a few minutes with the formation of large amounts of metallic uranium. A plot of the CH_4 evolution versus the square root of the time for the reduction process with pure hydrogen at constant temperature results in two straight lines, indicating that the process is diffusion-controlled. The first line corresponds to reaction of UC_2 to uranium monocarbide, the second to formation of metallic uranium from uranium monocarbide. The ratio of H_2/CH_4 in equilibrium with stoichiometric UC is determined. The reaction rate is considerably reduced by diluting the hydrogen with argon; with a mixture of 30 wt.% H_2 70 wt.% Ar, reduction of UC_2 proceeds to formation of only uranium monocarbide. The ternary phase diagram U–C–Me was examined for a number of metals. Two metals were found which stabilize UC, chromium and vanadium. Chromium addition is limited to forming $Cr_{23}C_6$; higher chromium carbides are not compatible with cladding materials and liquid sodium. The ternary U–C–V diagram has been found different from those mentioned in the literature. A new compound, corresponding to UVC_2, has been found. Uranium monocarbide, from reduction of hyperstoichiometric carbide or stabilized by metal addition, has been tested for compatibility with cladding materials, liquid sodium and diffusion barriers. When only single-phase UC is present, no carburization has been detected. (auth)

31450 NON-STOICHIOMETRY OF TANTALUM CARBIDE AND URANIUM MONOCARBIDE. Hoch, M. (Univ. of Cincinnati); Juenke, E. F.; Sjodahl, L. H. pp 497-510 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB–162; CONF-670915.

The thermodynamic behavior of non-stoichiometric TaC_x and UC_x, having the NaCl-type structure, was studied by measuring the C activity as a function of composition and temperature. TaC_x and UC_x ($x < 1$) were equilibrated at elevated temperature with hydrogen gas at 1 atm pressure containing various amounts of CH_4. The TaC_x was contained in a Re crucible, the UC_x (to avoid vaporization of U) in a closed Re capsule. The C activity in the gas was computed from thermodynamic functions; the composition of the solid was obtained from the lattice parameter. The experimental data were treated according to the statistical model derived earlier. In TaC_x, the activity coefficient can be expressed as $RT \ln [a_c(1-x)/x] = -26.9 \pm 1.6$ kcal/mole, $x \ll 1$ and $1773 < T < 1973°K$. In hyperstoichiometric $UC_x (x \gg 1)$, where $(x-1)$ C sites are doubly occupied, the activity coefficient for the second C atom can be expressed as $RT \ln [a_c(2-x)/(x-1)] = 6.8 \pm 0.5$ kcal/mole, $x \gg 1$, and $2100 < T < 2300°K$. In UC, the Frenkel energy (i.e., the energy required to move an atom from a singly occupied site to another occupied site and "double up") is 33.7 ± 1.7 kcal/mole. Thus, in stoichiometric $UC_{1.0}$, 1.4% of the C atoms are doubled up, i.e., are on wrong sites at 2000°K, and 3.3% are so located at 2500°K. (auth)

31451 SINTERING PARAMETERS FOR VARIOUS URANIUM DIOXIDE POWDERS. Ferro, C.; Majani, C.; Stamenkovic, I. (CNEN, Rome). pp 529-36 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB–162; CONF-670915.

Initial stages of the sintering process for various O_2 powders were investigated using dilatometric measurements. The results show that at any temperature the sintering process proceeds by two stages. The mean values of the experimental activation energy for sintering in H were determined. They varied from 40.5 to 51.4 kcal/mole for the first stage and from 57.0 to 65.1 kcal/mole for the second stage. The surface area was found to affect the activation energy. The densities corresponding to the limit between the two stages were from 50.0% TD to 64.0% TD. The temperature range of UO_2 powders starting sintering temperature was found to be 900 to 940°C. (auth)

31452 ENTHALPY OF FORMATION OF HAFNIUM DIOXIDE. Huber, Elmer J. Jr.; Holley, Charles E. Jr. (Los Alamos Scientific Lab., N. Mex.). J. Chem. Eng. Data, 13: 252-3(Apr. 1968). (LA-DC–8973).

The enthalpy of formation of hafnium dioxide was determined by means of an oxygen bomb calorimeter and is $\Delta H^0_{f298.15°K} = -273.6 \pm 0.3$ kcal/mole. (auth)

31453 ENTHALPIES OF FORMATION OF THORIUM MONO- AND DICARBIDES. Huber, Elmer J. Jr.; Holley, Charles E. Jr.; Krikorian, N. H. (Los Alamos Scientific Lab., N. Mex.). Contract W-7405-eng-36. J. Chem. Eng. Data, 13: 253-6(Apr. 1968). (LA-DC–8132).

A series of analyzed thorium carbides was burned in an oxygen bomb calorimeter. The enthalpies of formation of $ThC_{1.00\pm0.01}$ and $ThC_{1.91\pm0.01}$ were -29.6 ± 1.1 and -29.9 ± 1.1 kcal/mole, respectively, at 298.15°K. (auth)

31454 SOME URANIUM-TRANSITION ELEMENT DOUBLE OXIDES. Hoekstra, Henry R. (Argonne National Lab., Ill.); Marshall, Robert H. Advan. Chem. Ser., 71: 211-27(1967).

From Symposium on Lanthanide/Actinide Chemistry, New York. See CONF-660962.

The preparation and properties of some double oxides of uranium with the seven transition elements from chromium through zinc are described. Thirteen compounds with the composition MUO_4 or MU_3O_{10} were prepared by heating mixed oxides in air or in sealed silica tubes, by hydrothermal methods, and by high-pressure techniques. Four of these compounds, ($FeUO_4$, FeU_3O_{10}, $NiUO_4$, and $ZnUO_4$) were not previously reported. $NiUO_4$ was prepared in two crystal forms. The thermal stability, crystal structure, and infrared spectrum (from 1000 to 200 cm^{-1}) of each of the 13 compounds were investigated. The structure of $FeUO_4$ and $\alpha-NiUO_4$ is similar to $CrUO_4$, while $\beta-NiUO_4$ and $ZnUO_4$ crystallize in the $MgUO_4$ structure. FeU_3O_{10} has the pseudo-hexagonal lattice characteristic of the transition element triuranates. (auth)

31455 OBTAINING ZIRCONIUM CARBIDE ON A SEMI-INDUSTRIAL SCALE. Shumilova, R. G.; Kosolapova, T. Ya. (Inst. of Problems in Material Studies, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR, No. 4, 86-9(Apr. 1968). (In Russian).

It is possible to obtain zirconium carbide in electric resistance furnaces with a graphite heater in the hydrogen medium at 2200°C and an exposure time of 60 min. (auth)

31456 OBTAINING HIGH-POROUS MATERIALS FROM TITANIUM AND ZIRCONIUM CARBIDES. Samsonov, G. V.; Vitryanyuk, V. K.; Sysov, P. D. (Kiev Polytechnic Inst.). Porosh. Met., Akad. Nauk Ukr. SSR, No. 4, 22-8(Apr. 1968). (In Russian).

An investigation was made of the conditions of obtaining materials with high porosity from titanium and zirconium carbides directly during soot reduction of the oxides in a vacuum. The porosity of the obtained articles is 68 to 74% for zirconium carbide and 69 to 77% for titanium carbide. It is shown that introducing the finished carbides into the initial charge consisting of the oxides and soot, one can regulate the porosity and relative volumetric shrinkage because the introduced carbide particles are the crystallization nuclei and promote the activation of a sintering process. The effect of particle size of the introduced carbide on the activation of sintering is considered. Uniformity of the pore size of materials obtained directly in the reduction process of the oxides is shown. (auth)

Properties Evaluations

Refer also to abstracts 31360, 31372, and 31375.

31457 (AGN-8265) EVALUATION STUDY OF HASTELLOY X AS A NUCLEAR CLADDING. Quarterly Progress Report, October 1–December 31, 1967. (Aerojet-General Corp., San Ramon, Calif. Nuclear Div.). Feb. 1968. Contract AT(04-3)-368. 29p. Dep. CFSTI.

HASTELLOY X—creep testing in argon at 1300 and 1400°F, data and structural changes from (D.L.C.)

31458 COMPATIBILITY OF (U,Pu) CARBIDES WITH SELECTED COMMERCIAL AUSTENITIC ALLOYS. Latimer, T. W. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 99-100(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31459 VAPOR PRESSURE OF HYPOSTOICHIOMETRIC URANIA AS A FUNCTION OF COMPOSITION. Szwarc, R.; Latta, R. E. (General Electric Co., Cincinnati). Contract AT(40-1)-2847. J. Amer. Ceram. Soc., 51: 264-8(May 21, 1968).

The vapor pressure of hypostoichiometric urania was measured as a function of temperature for a series of compositions. The data were obtained by an entrainment technique in which weight loss of a specimen vaporizing at high temperatures in a stream of carrier gas is followed continuously with a recording thermobalance. Use of suitable atmospheres produced constant vaporizing compositions which vaporized pseudocongruently. Equations obtained for the vapor pressure are:

$$\mathrm{UO_{1.88}}\ \ln P_{\overline{M}}\ (\mathrm{atm}) = 15.2 \pm 0.4 - \frac{59{,}100 \pm 1000}{T\ (^\circ K)}$$

$$\mathrm{UO_{1.92}}\ \ln P_{\overline{M}}\ (\mathrm{atm}) = 14.6 \pm 0.6 - \frac{59{,}200 \pm 1700}{T\ (^\circ K)}$$

$$\mathrm{UO_{1.94}}\ \ln P_{\overline{M}}\ (\mathrm{atm}) = 15.1 \pm 1.5 - \frac{61{,}000 \pm 1500}{T\ (^\circ K)}$$

(auth)

31460 HIGH-TEMPERATURE ENTHALPY AND HEAT OF FUSION OF UO_2. Hein, R. A.; Flagella, P. N.; Conway, J. B. J. Amer. Ceram. Soc., 51: 291-2(May 21, 1968).

Enthalpy measurements on stoichiometric UO_2 using a drop-calorimeter technique were extended from 2700 to 3270°K by means of tungsten capsules. The enthalpy discontinuity at the melting point yielded a melting point of 3115 ± 20°K, and the heat of fusion was measured to be 18.2 ± 0.5 kcal/mole. The equation fitting the data between 1200 and 3100°K with a standard deviation of 396 cal/mole is: $H_T - H_{298^\circ K} = -11{,}688 + 31.937\ T - 9.573 \times 10^{-3}T^2 + 2.577 \times 10^{-6}T^3$. (D.L.C.)

31461 SPECTRAL REFLECTANCE OF SINTERED OXIDES. Schatz, Elihu A. (American Machine and Foundary Co., Alexandria, Va.). J. Amer. Ceram. Soc., 51: 287-9(May 21, 1968).

Spectral reflectance in the 0.23 to 2.65 μ region was measured on sintered oxides of Al_2O_3, CeO_2 TiO_2, Y_2O_3, and ZnO. The oxides were sintered at various temperatures up to 1550°C. Large changes in reflectance occurred as a result of different extents of sintering of the specimens. The data were interpreted in terms of changes in the distance between the particles, the water content, and the surface roughness. Loss of trace-water and decrease in surface roughness result in an increase in reflectance, whereas shrinkage of the specimen causes a decrease in reflectance. (auth)

31462 DIRECT MEASUREMENT AT 1100°C OF THE PARTIAL MOLAR MIXING ENTHALPIES OF OXYGEN IN UO_{2+x} CLOSE TO UO_2, USING A CALVET HIGH-TEMPERATURE MICROCALORIMETER. Gerdanian, P.; Dode, M. (Faculte des Sciences, Orsay, France). pp. 41-54 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968. (In French).

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

Microcalorimetric techniques for determination of enthalpies of O_2 in sintered UO_2 are described. (P.G.C.)

31463 THERMODYNAMIC PROPERTIES OF PLUTONIUM COMPOUNDS BY EMF TECHNIQUES. Campbell, G. M.; Mullins, L. J.; Leary, J. A. (Los Alamos Scientific Lab., N. Mex.). Contract W-7405-eng-36. pp 75-88 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968. (LA-DC-8619).

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

Emf cells based on the plutonium-plutonium chloride electrode have been used to determine high temperature thermodynamic properties of $PuCl_3$, molten salt solutions of $PuCl_3$, and Pu compounds. Both solid and molten salt electrolytic cells have been employed. Such cells present unique experimental problems because of the low melting point and the electronegative nature of Pu. Special experimental techniques have been employed to obtain reversible cell potentials. The free energy of formation based on emf measurements is reported for $PuCl_3$, PuN, $PuRu_2$, Pu_2C_3 and PuC. (auth)

31464 THERMODYNAMICS OF SEMI-METALLIC COMPOUNDS. Westrum, E. F. Jr.; Lyon, W. G. (Univ. of Michigan, Ann Arbor). pp 239-56 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

The status of thermal and thermochemical knowledge of the semi-metallic compounds is briefly evaluated and correlated with that of related alloys, intermetallic compounds, and semi-conducting compounds. Emphasis is focused on the actinide and lanthanide compounds with elements of groups IIIA, VA, and VIA. These binary compositions with NaCl and related structures occasion interactions of crystallographic, electronic, and magnetic contributions to the thermal behavior. Although actinide compounds have an obvious nuclear technological import, data on the corresponding lanthanide compositions provide a very useful extension of parameters as well as a basis for understanding the more complex relationships existing over truncated ranges in the actinides. For example, the five 5f–6d electronic orbital problem makes interpretation of electronic, magnetic data especially difficult. The complications introduced in both series by the conduction electrons hinder facile interpretation. The thermal properties of the lanthanide hexaborides are shown to exhibit largely unexplained anomalies and, like many of the other compounds discussed, offer interesting possibilities for technological and possibly nuclear applications. (auth)

31465 THERMOCHEMISTRY OF SOME URANIUM COMPOUNDS. O'Hare, P. A. G.; Settle, J. L.; Feder, H. M.; Hubbard, W. N. (Argonne National Lab., Ill.). pp 265-78 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

The standard enthalpies of formation, $\Delta H^0_{f298.15}$ (kcal/mol), of $UP_{0.992}$ (−75.2 ± 1.3), $US_{1.011}$ (−73.2 ± 3.6), $UN_{0.965}$ (−71.5 ± 1.1), $UN_{1.510}$ (−90.1 ± 1.7), and $UN_{1.690}$ (−94.1 ± 1.7), were measured by fluorine reaction calorimetry. The results for uranium phosphide and uranium sulfide, when combined with data from recent high-temperature studies, can be used to arrive at values for the heat of sublimation of uranium. (auth)

31466 STABLE COMPOSITION RANGE AND DECOMPOSITION PRESSURE OF UC-UN SOLID SOLUTION. Sano, T.; Katsura, M.; Kai, H. (Osaka Univ.). pp 301-15 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

An investigation designed to clarify the effect of temperature and N pressure on the composition range and to determine the decomposition pressure of $UC_{1-x}N_x$ as a function of temperature and x is described. A powdered sample, UC or $UC_{1-x}N_x$ with the values of x 0.35, 0.50, or 0.90, was placed on a W sheet heated by resistance in a controlled pressure chamber. After heating a sample to about 1600°C in vacuo, purified N was admitted to the desired pressure. Temperature was then increased rapidly to the chosen temperature between 1600 and 2500°C, where the sample was held for ten minutes. Lattice parameters were obtained from x-ray diffraction data for the solid solutions cooled quickly to room temperature from several temperatures above 1600°C. The lattice parameters vary with pressure of N and composition of starting solid solution, but they are nearly independent of the temperature at which the solid solutions had been held. In other words, a temperature range exists where the composition of a solid solution is constant for a fixed pressure of N until decomposition occurs. This fact makes possible the determination of the decomposition temperature of $UC_{1-x}N_x$ with a constant composition as a function of pressure of N. The decomposition temperature of UC, $UC_{1-x}N_x$ or UN was determined in the temperature range 2000 to 2500°C by observing the apparent melting point. Thermodynamic discussions have been made for the decomposition of $UC_{1-x}N_x$ on the basis of the experimental results. (auth)

31467 STABILITY OF UC–UN SOLID SOLUTIONS IN THE PRESENCE OF FREE CARBON. Naoumidis, A.; Stoecker, H.-J. (Kernforschungsanlage, Juelich, Ger.). pp 287-300 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB–162; CONF-670915.

The nitrogen equilibrium pressure over mixtures of UC–UN solid solutions and free C was measured as a function of temperature and composition of the solid solutions. The temperature range was 1350 to 1800°C, the pressure range 5×10^{-2} to 10^3 torr. From these measurements the partial molar values were calculated for N dissolution in solid solutions of various compositions. The phases were identified by x-ray and metallographic examination and the composition of the solid solutions was determined by chemical analysis for N, C, and O. The practical application of the data obtained with regard to preparation processes and hot-pressing is discussed. The principles of a new method of O analysis, which is based on the transformation of carbides into carbonitrides, by reaction with N with the simultaneous formation of free C are briefly outlined. (auth)

31468 IDEALITY OF THE UC–UN SOLID SOLUTIONS. Leitnaker, J. M. (Oak Ridge National Lab., Tenn.). pp 317-30 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB–162; CONF-670915.

Both UN and UC have potential as nuclear fuels. A solid solution of the two may be even more attractive. The work reported was undertaken to provide basic thermodynamic data on these solid solutions. Precise x-ray lattice parameters have been measured at room temperature for UC reacted with N between 1500 and 1900°C and for UN reacted with graphite at 1500 and 1700°C. The data are used together with free energy functions from the literature to calculate ΔH^0_{298} for the reaction $UC(s) + \frac{1}{2} N_2(g) = UN(s) + C(graphite)$. In these calculations it was assumed that Vegard's law applies. Results indicate that the system is ideal from 0.3 to 0.9 mole fraction UN and that ΔH^0_{298} for the reaction given is -47.19 ± 0.38 kcal, where the error quoted is twice the maximum deviation. Twenty-one measurements at 1500°C on UC reacted with N yield a "ΔH^0_{298}" of -46.58 ± 0.02 kcal; the C released in the reaction is shown to be in a higher energy state than graphite. (auth)

31469 SOLID SOLUBILITY IN NaCl-TYPE URANIUM COMPOUNDS. Imoto, S. (Osaka Univ.); Niihara, K.; Stoecker, H.-J. pp 371-83 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB–162; CONF-670915.

Solubility limits of (UB), UC, UN, (UO), USi, UP and US in UC, UN, UP and US were studied using data from a literature search and from experimental investigations. It was found that valence electron concentration strongly influences the solution behavior, often overcoming "atomic radii" limitations. The data are explained by the hypothesis that in solution systems involving second and third row U compounds with NaCl-structure, valence electron concentrations of about 10.5 and 11.3, respectively, are favored. (auth)

31470 THERMODYNAMIC PROPERTIES OF URANIUM COMPOUNDS. PART 4. LOW-TEMPERATURE HEAT CAPACITIES AND ENTROPIES OF US–UP SOLID SOLUTIONS. Counsell, J. F. (National Physical Lab., Teddington, Eng.); Martin, J. F.; Dell, R. M.; Junkison, A. R. pp 385-94 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB–162; CONF-670915.

Low temperature heat capacities at 11 to 320°K of three compositions in the US-UP solid solution range have been measured. These were nominally $U(S_{0.75}P_{0.25})$, $U(S_{0.5}P_{0.5})$, $U(S_{0.25}P_{0.75})$. All three compositions showed an anomaly in the C_p curves associated with magnetic ordering, the transition temperatures being 165, 142, and 98°K respectively. As P is progressively substituted for S in US, the magnetic ordering temperature decreases and the entropy increment ΔS_t becomes smaller also. From these and other experiments it is concluded that ferromagnetic interactions predominate over antiferromagnetic interactions in this system. The entropy results suggest a loss of long range order. (auth)

31471 ACTINIDE CARBIDES: A REVIEW OF THERMODYNAMIC PROPERTIES. Holley, C. E. Jr.; Storms, E. K. (Los Alamos Scientific Lab., N. Mex.). pp 397-426 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB–162; CONF-670915.

The present state of knowledge of the thermodynamic properties of the actinide carbides and areas in which further work is needed is reviewed. 70 references. (auth)

31472 . THERMODYNAMIC PROPERTIES OF NON-STOICHIOMETRIC VANADIUM AND TITANIUM CARBIDES. Alekseev, V. I.; Panov, A. S.; Fiveiskii, E. V.; Shvartsman, L. A. (State Committee of Atomic Energy Recovery, Moscow). pp 435-47 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968. (In Russian).

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB–162; CONF-670915.

The dependence of carbon activity on composition and temperature in non-stoichiometric vanadium and titanium carbides was determined. The investigations were carried out at 973 to 1223°K. Carbon activity was determined by the method of investigating gaseous equilibria in the system H_2-CH_4-C (in the carbide). It was found that, when the ratio at.%C/at.%Me changes within the homogeneity region, the carbon activity changes by more than two orders of magnitude. In vanadium carbide at 1000°K, for example, the carbon activity increases by a factor of 500 when the ratio at.%C/at.%V changes from 0.6 to 0.93. An equation is derived describing the composition-dependence of carbon activity. From an analysis of the temperature dependences it is established that the change in carbon activity within the homogeneity region of the vanadium and titanium carbides is due to the effect of both the enthalpy and the entropy terms. The partial molar free energy of the carbon in the vanadium and titanium carbides is calculated and using the Gibbs-Duhem equation, the partial molar free energies of the vanadium and titanium are estimated. The total free energies of the vanadium and titanium carbides are calculated and compared with published data for non-stoichiometric niobium, thorium, uranium, and hafnium carbides. The results and those found in the literature are discussed on the basis of statistical thermodynamics concepts. (auth)

31473 CALCULATION OF CONFIGURATIONAL AND EXCESS ENTROPIES IN METAL CARBIDE SOLUTION TRANSITION. Andrievskii, R. A.; Zagryazkin, V. N.; Lyutikov, R. A. (Inst. of Energetic Physics, Obninsk, USSR). pp 449-56 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968. (In Russian).

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB–162; CONF-670915.

The integral and partial configuration entropies for solid solutions of carbides are calculated. In order to assess the contributions to excess entropy, data on the magnetic susceptibility, electronic heat capacity, ordering, and characteristic temperature in systems of carbides of transition metals in groups IV-VI are examined and analyzed. Analysis of these results shows that nonconfigurational (i.e., electronic, magnetic and vibrational) contributions to entropy may be ignored for solutions formed by carbides of metals of a single group in the periodic system, or for diluted carbide solutions. The quantities obtained for excess entropies are discussed in connection with data on heats of mixing and entropies of formation in carbide systems. (auth)

31474 EQUILIBRIUM DISSOCIATION PRESSURES AND PERFORMANCE OF PULSED U–ZrH FUELS AT ELEVATED TEMPERATURES. Simnad, M. T.; Dee, J. B. (General Atomics Div., General Dynamics Corp., San Diego, Calif.). pp 513-27 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB–162; CONF-670915.

Pressure-temperature isochores have been obtained for zirconium-hydrogen and uranium-zirconium-hydrogen alloys at 900 to 1300°C. The compositions spanned the H/Zr range from 1.50 to 1.70, and the uranium contents were 0 and 8%. The equilibrium dissociation pressures at the elevated temperature for the H/Zr range from 1.60 to 1.70 were found to agree with values extrapolated from data previously reported for temperatures below 900°C. However, for the H/Zr range from 1.50 to 1.55, the equilibrium dissociation pressures at temperatures above 1000°C are significantly lower than the extrapolated pressures. For example, at a H/Zr ratio of 1.5, the measured dissociation pressure at 1100°C is 7.6 atm as compared with an extrapolated value of 19.0 atm, and the measured pressure at 1200°C is 11.5 atm as compared with an extrapolated value of 56 atm. An in-pile test has been performed on fuel elements modified in design for high-performance pulse operation. To investigate fuel behavior at high temperature, fully enriched test fuel elements 15 in. in length and 1½ in. in diameter, having compositions of 8 wt.% $U-ZrH_{1.60-1.65}$ were loaded in the TRIGA Mark F reactor and pulsed. A small gas gap around the fuel was provided by "dimples" in the 304 stainless steel cladding. The purpose of this gap was to introduce a small thermal resistance to control heat flow rates from the fuel immediately after pulsed operation. This special construction was observed to be effective in preventing the occurrence of film boiling during the cooling-off period, while still permitting sufficiently rapid cooling to restore fuel temperatures to pre-pulse cold conditions in approximately 5 min. After 400 pulses, selected elements were declad and subjected to metallographic examinations. These examinations showed that fuel-body performance at temperatures up to the design point of 1000°C was satisfactory. (By comparison, 500°C is the maximum temperature in a standard TRIGA pulse reactor installation.) There was no evidence of interaction between the cladding and the fuel. The transient gas pressure in the space between the fuel and the cladding was measured during the pulse, and peak pressures were less than 40 lb/in^2(gage)—well below the upper bound implied by the equilibrium-pressure data. (auth)

31475 ISOTHERMIC DIFFERENTIAL THERMAL ANALYSIS OF UO_2 OXIDATION. Gasic, M. C.; Boskovic, S. B.; Mikijelj, V. D.; Ristic, M. M. (Boris Kidric Inst. of Nuclear Physics, Belgrade). pp 537-43 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

Oxidation of UO_2 was investigated on a specially adapted apparatus for isothermic DTA. The results were compared, from the thermodynamic point of view, with the results obtained earlier. For correct characterization of the whole process the x-ray investigations of the reaction products were considered. A conclusion on the thermochemistry of oxidation is drawn, and a method for isothermic DTA for enthalpy change determinations in the oxidation of sintered UO_2 is suggested. (auth)

31476 THERMAL DIFFUSION IN NUCLEAR REACTOR FUELS. Wirtz, K. (Kernforschungszentrum, Karlsruhe, Ger.). J. Amer. Chem. Soc., 90: 3098-9(June 5, 1968).

Experiments on the thermal diffusion of mixtures of CeO_2-UO_2 and PuO_2-UO_2 are discussed in the light of the kinetic model of thermal diffusion. The heats of transfer Q^+ are derived from these experiments: for CeO_2-UO_2 at 2050°K, $Q^+ = 25$ kcal/mol; for PuO_2-UO_2 at 2673°K, $Q^+ = 58$ kcal/mol. In both cases the result of the kinetic model that the heat of transfer should be lower than the heat of activation for the rate-determining step is confirmed. Future work is briefly discussed. (auth)

31477 EVAPORATION BEHAVIOUR AND HIGH-TEMPERATURE THERMAL ANALYSIS OF SUBSTOICHIOMETRIC PLUTONIUM OXIDE FOR $1.51 < O/Pu < 2.00$. Ohse, R. W.; Ciani, C. (EURATOM, Karlsruhe, Ger.). pp 545-57 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

The substoichiometric range of PuO_2 was investigated by evaporation studies in both Ta and W cells using the effusion technique and high-temperature thermal analysis. The vapor pressure of Pu bearing species was measured as a function of temperature and composition. Three isotherms in a pressure-composition diagram at 1800, 2000, and 2200°K yield a bivariant behavior in the single phase region from O/Pu = 1.61 to 2.00 and a univariant behavior in the two phase region O/Pu = 1.51 to 1.61. The vapor pressure was found to decrease from both limits of the single phase region towards a minimum at the congruently evaporating composition. It is shown by the initial rapid rate of decomposition of $PuO_{2.00}$, evidence for a preferential loss of oxygen, and the effusion technique cannot be applied to the near stoichiometric oxide. Discrepancies in this region are discussed. The contradictory results in the two-phase region O/Pu = 1.51 to 1.61 could be explained by effusion measurements in Ta and W cells, by the investigation of the rate and mechanism of decomposition in open and closed Ta cells and finally by locating the phase limit of the single phase region PuO_{2-x} by using a high-temperature thermal arrest technique. It is shown that the previous results obtained in Ta cells do not represent equilibrium pressure but depend on geometrical factors and on time of thermal treatment. (auth)

31478 MIXED CONDUCTION IN SOLID OXIDE ELECTROLYTES. Rapp, R. A. (Ohio State Univ., Columbus). pp 559-85 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

At temperatures between 800 and 1100°C electrical conductivity and galvanic cell measurements indicate that over a broad intermediate range of O activity pure ThO_2 is an ionic conductor, which becomes a p-type electronic conductor at higher P_{O_2}. These measurements for "pure" ThO_2 are best rationalized by assuming that the ionic defects result from the presence of trace impurities. Preliminary conductivity measurements for pure Dy_2O_3 and Gd_2O_3 do not correlate with any simple defect model. The P_{O_2}-dependence of ac conductivity measurements in $ThO_2-Y_2O_3$ solid solutions shows a wide P_{O_2}-range of predominant ionic conductivity (σ_{ion}), with significant positive hole contributions ($\sigma_\oplus$) at higher oxygen activities. A dilute solution model has been used to interpret the dependences of $\sigma_\oplus$ on P_{O_2} and Y_2O_3 content. The behavior of $\sigma_\oplus$ is consistent with the existence of doubly ionized (unassociated) O vacancies in electrical compensation of trivalent dopant ions. As previously reported, the ionic conductivity contribution reaches a maximum with increasing Y_2O_3 dopant content. No significant excess electron conductivity contribution ($\sigma_\ominus$) was indicated for any $ThO_2-Y_2O_3$ composition at O activities as low as those for Cr–Cr_2O_3 equilibrium coexistence. A dc polarization technique was used for the direct measurement of $\sigma_\oplus$ and $\sigma_\ominus$ in $Zr_{0.85}Ca_{0.15}O_{1.85}$ and $Th_{0.85}Y_{0.15}O_{1.925}$ electrolytes. An improved method for the analysis of the data and experimental difficulties of this technique are discussed. A lower limit in P_{O_2} for predominant ionic conduction is reported for each electrolyte. Galvanic cells involving the use of the $Zr_{0.85}Ca_{0.15}O_{1.85}$ electrolyte were used to determine the solubility and diffusivity of O in solid Cu. Difficulties in the method and the reliability of the results are discussed. (auth)

31479 SOME THERMODYNAMIC ASPECTS OF $(U,Pu)O_2$ SOLID SOLUTIONS AND THEIR USE AS NUCLEAR FUELS. Rand, M. H.; Markin, T. L. (Atomic Energy Research Establishment, Harwell, Eng.). pp 637-50 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

Since the free energy data for the solid $(U,Pu)O_{2\pm y}$ can be derived from O potential measurements, the pressure and composition of the vapor above these mixed oxides can be calculated. The results of such calculations are presented for a typical Pu composition. Since the O potentials of the mixed oxides close to the $(U,Pu)O_2$ composition are much higher than that of UO_2, the predominant species over such oxides is initially UO_3(g) rather than UO_2(g). Since the U/Pu ratios in the solid and vapour are not equal, when a mixed oxide is heated indefinitely in vacuo, both the U/Pu and O/(U + Pu) ratios change continuously. The results of iterative calculations for such cases are presented. Because of the poor thermal conductivity of the oxides, during operation there will be a temperature difference of nearly 1000°C between the outer surface and the center of the fuel pin. It is suggested that under normal irradiation conditions, the gradient of O composition across the fuel will be determined by a constant CO/CO_2 or H_2/H_2O ratio in the gas phase (the gas permeating via cracks) rather than by a constant O potential. Calculations are given for a typical temperature profile for a fuel clad with stainless steel. There is little effect for initially stoichiometric oxides but for both hypo- and hyper-stoichiometric material, the center of the fuel will become more nonstoichiometric than the outer surface. In addition, changes in the fissile material content may occur, particularly in hyperstoichiometric fuels, as a result of the large pressure gradients that will be set up. The possible effects of the variation in O potential during a long irradiation are considered briefly. (auth)

31480 HIGH-TEMPERATURE HEAT CONTENT AND HEAT CAPACITY OF URANIUM DIOXIDE AND URANIUM DIOXIDE–PLUTONIUM DIOXIDE SOLID SOLUTIONS. Ogard, A. E.; Leary, J. A. (Los Alamos Scientific Lab., N. Mex.). pp 651-65 of

Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

The heat capacity of UO_2 has been determined by high-temperature drop calorimetry. Results agree very well with those of Moore and Kelley in the temperature range 900 to 1650°C. However, above 1650°C the heat capacity increases rapidly in the manner reported by Conway and Hein. The literature is void of any information as to the effects of stoichiometry and metal composition on the high-temperature heat capacity of solid solutions of actinide oxides. Since the solid solution $U_{0.8}Pu_{0.2}O_{2\pm x}$ is a promising reactor fuel, the heat content and heat capacity of $U_{0.802}Pu_{0.198}O_{2.00}$ and $U_{0.802}Pu_{0.198}O_{1.98}$ have also been determined. The heat capacity of both the solid solution oxides was found to be greater than for UO_2 itself, with the stoichiometric $U_{0.802}Pu_{0.198}O_{2.00}$ exhibiting the largest heat capacity. (auth)

31481 ENTROPY AND HEAT CAPACITY OF URANIUM BORIDES. Podobeda, L. G.; Malykh, V. A.; Frolov, A. V. (State Committee of Atomic Energy Recovery, Moscow). pp 745-65 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968. (In Russian).

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

The results of a theoretical determination of the standard values of the entropy and heat capacity and the temperature dependence of the heat capacity of uranium borides are reported. Use was made of new approaches, as well as of most of the currently known methods of calculating by empirical formulas and relationships. Comparison of the thermodynamic constants in series of diborides of the same type reveals a number of relationships between the heat capacity and the physical constants of the diborides. (auth)

31482 EFFECT OF CARBON ON THE STRENGTH OF THORIUM. Peterson, D. T.; Skaggs, R. L. (Iowa State Univ., Ames). Trans. Met. Soc. AIME, 242: 922-9(May 1968).

The effect of carbon in solid solution on the plastic behavior of thorium was studied by measuring the flow stress of Th–C alloys from 4.2 to 573°K and at several strain rates. Carbon was found to strengthen thorium primarily by increasing the thermally activated component of the flow stress. The strengthening due to carbon was directly proportional to the carbon content and decreased rapidly with increasing temperature up to 423°K. The flow stress also increased with increasing strain rate. The strengthening appears to be due to a strong short-range interaction between carbon atoms and dislocations. A yield point was observed in the Th–C alloys which increased with increasing carbon content. (auth)

31483 TRANSPORT PHENOMENONS IN CUBIC PHASES OF FLUORITE TYPE, RELATED TO ZIRCONIA. Paidassi, J.; Caillat, R. (CEN de Saclay, Gif-sur-Yvette, France). Rev. Int. Hautes Temp. Refract., 5: 27-44(Jan.-Mar. 1968). (In French).

Results on the electric conductivity of binary stabilized zirconias having a formula: $(ZrO_2)_{1-y}(MO)_y$ or $(ZrO_2)_{1-y}(M_2O_3)_y$ are explained and discussed. The crystal structure of these compounds (cubic of fluorite type) must have two kinds of defects: metallic addition ions M^{x+} (as substituents in the cationic network) and oxygen vacancies (their number being equal to the number of addition cations for x = 2). These two kinds of defects are probably partly related. Their formulas are: $Zr^{4+}_{1-y}M^{x+}_yO^{2-}_{2-(4-x)y/2}\square_{(4-x)y/2}$ with x = 2 or 3. Under these conditions their electric conductivity must have a very strong anionic preponderance. Experimentation proved it, at least for completely stabilized zirconias $(ZrO_2)_{0.85}(CaO)_{0.15}$ and $(ZrO_2)_{0.90}(Y_2O_3)_{0.10}$ the only zirconias which have been studied in detail. Then: (1) The measured conductivity and the one calculated by the Nersnt–Einstein relation are equal. (2) The conductivity is independent of the oxygen pressure. (3) The values of the electronic and cationic transport numbers are very low. Running of dc current in these materials produces an electrolysis the effects of which are described, and the consequences of which are discussed. The results of conductivity measurements on zirconias stabilized with the following oxides: CaO, Sc_2O_3, Yb_2O_3, Y_2O_3 and Sm_2O_3 (in every case $r_{M^{x+}} > r_{Zr^{4+}}$) are gathered and discussed. (auth)

31484 MECHANICAL PROPERTIES AT HIGH TEMPERATURES OF SOME ULTRAREFRACTORY CARBIDES. Hivert, A.; Poulignier, J. Rev. Int. Hautes Temp. Refract., 5: 55-61 (Jan.-Mar. 1968). (In French).

Among the materials which might be used instead of graphite at high temperatures, the carbides of the transition metals of the fourth and fifth groups of the periodic table of the elements are interesting because of their exceptional refractoriness. A study of their tensile strength as a function of the temperature, carried out with an improved device, showed differences between the different carbides, and also differences between these carbides and graphite. Only tantalum carbide shows a real advantage compared to graphite, from room temperature to 3200°C. Its thermal-shock resistance is intrinsically low, but can be slightly increased, when impregnating porous shards of it with metals such as copper or silver which have a good thermal conductibility. (auth)

31485 INFLUENCE OF Nb_2O_5, MnO_2, ZrO_2, AND Na_4AlF_6 ON THE RECRYSTALLIZATION OF CORUNDUM. Kowatschew, I. (Wissenschaftliches Forschungsinstitut fuer Elektroindustrie, Sofia). Compt. Rend. Acad. Bulg. Sci., 20: 1145-8(1967). (In Bulgarian).

The effect of Nb_2O_5, MnO_2, ZrO_2, and Na_3AlF_6 on the growth processes of corundum crystals was studied. The results of the micrographic study shows that Nb_2O_5 and ZrO_2 promote sintering but inhibit recrystallization. Only MnO_2 exerts a positive effect on both processes. The coarsest grain structure was found in the addition of Na_3AlF_6. (J.S.R.)

31486 HEAT CONTENT AND HEAT CAPACITY OF TANTALUM CARBIDE IN THE HOMOGENEITY REGION. Bolgar, A. S.; Guseva, E. A.; Gorbatyuk, V. A.; Fesenko, V. V. (Inst. of Problems in Material Studies, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR, No. 4, 60-2(Apr. 1968). (In Russian).

Heat content and heat capacity of tantalum carbide in the homogeneity region were determined by means of a high-vacuum high-temperature calorimetric installation for the temperature range 1200 to 2200°K. A dependence of heat capacity on the composition is found. Enthalpy, heat capacity, entropy, and reduced thermodynamic potential of the carbide $TaC_{0.99}$ at 298 to 2500°K are tabulated. (auth)

Structure and Phase Studies

Refer also to abstracts 31386, 31399, and 31995.

31487 (KFK-721) ZUR MISCHKRISTALLBILDUNG IN DEN QUASIBINAEREN SYSTEMEN VON UN UND DEN MONONITRIDEN DER IV A-GRUPPE TiN, ZrN, UND HfN. (Mixed Crystal Formation in the Quasibinary Systems of UN and the Mononitrides of Group IV-A TiN, ZrN, and HfN). Holleck, H.; Smailos, E.; Thuemmler, F. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material- und Festkoerperforschung). Jan. 1968. 11p. (In German). Dep.

The systems of UN with the nitrides of the IV-A transition metals Ti, Zr, and Hf behave completely analogously to the systems with UC: low solubility for TiN (TiC) and complete miscibility with ZrN (ZrC) and HfN (HfC). The critical miscibility temperatures can not be determined. Mixed phases with 50 mole % ZrN or HfN, which were annealed for 48 hr at 1050°C, showed no segregation phenomena. Two explanations are offered for the accelerated equilibrium attainment by U_2N_3 formation: (1) diffusion-preventing UO_2 films were destroyed during the intermediary U_2N_3 formation, so that the volume changes during the reaction can be the origin. It is known that sinter processes in UN are strongly inhibited by such films; (2) the UN is formed in the decomposition of U_2N_3 first in an active form which reacts directly during its formation. It was assumed that the first process has the greatest influence. (tr-auth)

31488 (ORNL-tr-1890) SPIRAL GROWTH IN PYROLYTIC CARBON. Fitzer, E.; Schlesinger, H. Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from Carbon, 3: 247-55(1965). 16p. Dep. CFSTI.

This paper was abstracted from the original language and appeared in NSA as 20: 23675. (R.C.K.)

31489 REVISION OF THE VANADIUM–CARBON AND NIOBIUM–CARBON SYSTEMS. Rudy, E.; Windisch, St.; Brukl, C. E. (Aerojet-General Corp., Sacramento, Calif.). Planseeber. Pulvermet., 16: No. 1, 3-33(Apr. 1968).

The binary systems V–C and Nb–C were reinvestigated by means of x-ray, melting point, and differential-thermoanalytical techniques on chemically and thermally characterized alloys; revised phase diagrams for both systems are given. The orthorhombic, low temperature modification of V_2C transforms in a homogeneous reaction at approximately 800°C into the disordered hexagonal high temperature form. The phase which has a homogeneity range of less than 1 at.% below 1000°C and extends from 27 to ≈33 at.% C at 1650°C, melts peritectically at 2187°C. The cubic (Bl) monocarbide, VC, melts congruently at 2648°C at 43 at.% C. The high-carbon boundary of the phase decreases from 47 at.% C at 1000°C (a = 4.172 Å) to 46 at.% at 2625°C (a = 4.164 Å). The low-carbon boundary is strongly temperature dependent, and varies from 37 at.% C at 2200°C, 40.4 at.% C at

1800°C (a = 4.131 Å), to ≈43 at.% C at temperatures below 1500°C. The presence of the ζ-phase was observed at temperatures below ≈1500°C. The following reaction isotherms were found (concentrations in at.% carbon): 1. L(49.5) ⇌ VC (46) + C (>98) at 2625° ± 12°C; 2. L (28) + VC (37) ⇌ V_2C (β) (35) at 2187° ± 10°C; 3. L (15) ⇌ V (5.5) + V_2C (β) (27) at 1650° ± 7°C. Nb_2C exists in three different modifications: an orthorhombic, ordered form, stable between room temperature and 1230°C; a hexagonal, ordered modification, presumably of the ε-Fe_2N-type, between 1230°C and approximately 2500°C; and a hexagonal modification (disordered, L′3-type) between 2500°C and the melting temperature (3035°C). The phase extends from 28 to ≈33 at.% C at 2353°C and has a homogeneity range of less than 1 at.% C at temperatures below 1200°C. The cubic (B1) monocarbide, NbC, melts congruently at 3613°C at 44 at.% C. The phase extends from 37 to ≈49 at.% C at 3000°C and from 41.3 at.% C (4.431 Å) to ≈49.5 at.% C (a = 4.470 Å) at 2200°C. The lattice parameters found for the defect monocarbide are in good agreement with the values determined earlier by G. Brauer and co-workers. Diffusion experiments indicate the ζ-phase to be metastable and its appearance to result from a non-equilibrium precipitation from the cubic monocarbide during cooling. The following reaction isotherms were found (concentrations in at.% C): 1. L (60) ⇌ NbC (~49) + C (>98) at 3305 ± 20°C; 2. L (30) + NbC (37) ⇌ Nb_2C(γ) (~34.5) at 3035 ± 20°C; 3. Nb_2C (γ) (~33.5) ⇌ Nb_2C (β) (~33) + NbC (~41) at ~2440°C; 4. L (10.5) ⇌ Nb (7.5) + Nb_2C (β) (28) at 2353 ± 10°C. (auth)

31490 THE CHEMICAL EQUILIBRIA OF FISSION-PRODUCT FUEL MIXTURES: THE GAS-PHASE COMPOSITION OF THE URANIUM–OXYGEN–STRONTIUM SYSTEM IN THE PRESENCE OF THE CONDENSED PHASE. Fontana, M. H. (Oak Ridge National Lab., Tenn.); Bailey, R. E. Trans. Amer. Nucl. Soc., 11: 376-7(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31491 REACTIONS OF $PbWO_4$ WITH $ZnWO_4$ AND $CaWO_4$. Kislyakov, I. P.; Smirnova, I. N.; Paklenkov, E. A. (Moscow Inst. of Fine Chemical Technology). Izv. Akad. Nauk SSSR, Neorg. Mater., 4: 791-2(May 1968). (In Russian).

A constitution diagram of $PbWO_4 - ZnWO_4$ was constructed. The melting point for $PbWO_4$ was found at 1120°C and for $ZnWO_4$ at 1212°C. Eutectic composition is 32 to 35 mole % $ZnWO_4$ and the temperature of eutectic melting is 982 to 990°C. Phase transformation temperatures for $PbWO_4 - ZnWO_4$ system are tabulated, as well as the melting temperatures of mixtures in the $CaWO_4$–$PbWO_4$ system. (R.V.J.)

31492 THE SINTERING OF CRYSTALLINE OXIDES. I. INTERACTIONS BETWEEN GRAIN BOUNDARIES AND PORES. Kingery, W. D.; Francois, B. (Massachusetts Inst. of Tech., Cambridge). pp 471-98 of Sintering and Related Phenomena. Proceedings of the International Conference, Univ. of Notre Dame. Kuczynski, G. C.; Hooton, N. A.; Gibbon, C. F. (eds.). New York, Gordon and Breach, Science Publishers, 1967.

See CONF-650644.

On the basis of the generally accepted picture of pore elimination by diffusive processes as a result of surface energy, the interactions between grain boundaries and pores are discussed with particular attention devoted to the later stages of the sintering process. Effects of the relative location, size, and concentration of grain boundaries and pores are discussed. Attention is directed to the influence of the dihedral angle at a pore-grain boundary intersection, the relative mobilities of pores and grain boundaries, local variations in pore concentration, and gas trapped in pores. (auth)

31493 THE SINTERING OF CRYSTALLINE OXIDES. II. DENSIFICATION AND MICROSTRUCTURE DEVELOPMENT IN UO_2. Francois, B. ([Societe Francaise de Metallurgie, Paris]); Kingery, W. D. pp 499-525 of Sintering and Related Phenomena. Proceedings of the International Conference, Univ. of Notre Dame. Kuczynski, G. C.; Hooton, N. A.; Gibbon, C. F. (eds.). New York, Gordon and Breach, Science Publishers, 1967.

See CONF-650644.

A study of the microstructure changes and density in UO_2 sintered with rapid heating in hydrogen shows that it is possible to obtain structures with all the residual porosity located at junctions between grains. When this occurs densification practically stops and the type of microstructure and the density remain stable over a wide range of time and temperature. A small concentration of carbon (of the order of 10 ppM) reacting to form CO at a critical point during sintering is believed to be responsible for this behavior. This interpretation is supported by the geometry of the pores and by direct analysis of the carbon extracted as CO after sintering. (auth)

31494 SINTERING OF TaB_2. Elliot, A. Grant; Lavendel, H. W. (Lockheed Missiles and Space Co., Palo Alto, Calif.). pp 565-79 of Sintering and Related Phenomena. Proceedings of the International Conference, Univ. of Notre Dame. Kuczynski, G. C.; Hooton, N. A.; Gibbon, C. F. (eds.). New York, Gordon and Breach, Science Publishers, 1967.

See CONF-650644.

The shrinkage behavior of TaB_2 powder compacts was examined under vacuum conditions at 1100 to 2100°C. 94% theoretical density was obtained in ½ hour at 2100°C. Isothermal shrinkage rates were obtained at 1200 to 1500°C under both vacuum and inert atmosphere conditions. Initial stage sintering occurs via either a volume or a grain boundary diffusion mechanism, with an activation energy of approximately 90 kcal/mole. Compacts of a mechanical mixture of powder of TaB_2 + B in excess of stoichiometry expanded upon sintering. (auth)

31495 INTERDEPENDENCE OF PORE REMOVAL AND GRAIN GROWTH DURING LATER STAGES OF SINTERING IN BERYLLIUM OXIDE. Bannister, M. J. (Australian Atomic Energy Commission, Research Establishment, Lucas Heights, Australia). pp 581-605 of Sintering and Related Phenomena. Proceedings of the International Conference, Univ. of Notre Dame. Kuczynski, G. C.; Hooton, N. A.; Gibbon, C. F. (eds.). New York, Gordon and Breach, Science Publishers, 1967.

See CONF-650644.

Grain growth during the last stages of sintering of UOX-grade beryllium oxide obeyed the ideal (grain size) $\propto$ (time)$^{1/3}$ relationship, despite variation in compact green density or powder lot number. However, the actual grain growth rate was sensitive to green density, suggesting the grain growth, in fact, depended on pore removal. Despite variation in compact green density or powder lot number, densification over the porosity range 20% to approximately 2% followed the relationship (porosity) $\propto$ (time)$^{-1/3}$. This is the law predicted by the Coble intermediate stage sintering model, for material showing the observed dependence of grain size on time, and with the volume diffusion as the operative sintering mechanism. However, calculated diffusion coefficients were sensitive to green density, and this is shown to suggest that pore shrinkage may have been enhanced by grain boundary movement. (auth)

31496 VARIATION IN SHRINKAGE RATE WITH DIRECTION IN BeO CONTAINING ORIENTED NEEDLES. Sjodahl, Lars H. pp 607-15 of Sintering and Related Phenomena. Proceedings of the International Conference, Univ. of Notre Dame. Kuczynski, G. C.; Hooton, N. A.; Gibbon, C. F. (eds.). New York, Gordon and Breach, Science Publishers, 1967.

See CONF-650644.

Linear shrinkage in extruded cylindrical BeO rods containing axially oriented, relatively large, acicular particles of BeO is shown to be as much as three times as great in the radial direction as in the axial (extrusion) direction. Shrinkage varies as the 0.31 power of time in the radial direction and as the 0.24 power in the axial direction. Different geometrical particle contact in the two directions is indicated. (auth)

31497 SINTERING STUDY OF AL_2O_3 AND ZrO_2 SUB-MICRON PARTICLES BY ELECTRON MICROSCOPY. Vahldiek, F. W.; Swihart, D. E.; Mersol, S. A. (Air Force Materials Lab., Wright-Patterson AFB, Ohio). pp 617-35 of Sintering and Related Phenomena. Proceedings of the International Conference, Univ. of Notre Dame. Kuczynski, G. C.; Hooton, N. A.; Gibbon, C. F. (eds.). New York, Gordon and Breach, Science Publishers, 1967.

See CONF-650644.

Neck growth rates of spherical particles of Al_2O_3 and ZrO_2 (99.7% pure, particles sizes ranging from 50 to 750 Å) were studied at 600 to 1200°C by electron microscopy. Growth rates were determined in situ with an electron microscope equipped with a 16 mm movie camera. Sintering rates were also studied in compact and loose powder form at similar temperatures in helium atmosphere up to 72 hours using a SiC resistance furnace. Growth rate determinations for Al_2O_3 and ZrO_2 at 600 and 800°C indicated a neck growth rate following an x^2 vs time relationship for similar (400 Å in diameter) spheres. (auth)

31498 DETERMINATION OF ENTHALPY CHANGES FOR PHASE TRANSFORMATIONS ABOVE 2000°K. Kaznoff, A. I.; Grossman, L. N. (General Electric Co., Pleasanton, Calif.). pp 25-39 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

Apparatus and experimental procedures for determining the enthalpy associated with first order phase changes are described. Heats of fusion at temperatures not readily accessible by calorimetric methods have been determined by measuring the duration of near-isothermal conditions and the experimental determination of the effective thermal emittance of the crucible. This technique also eliminated the necessity of determining heats of fusion from the difference of large values of heat contents referred to a low temperature; for example, measurements on UO_2 can be accomplished within 100°K of the melting point for that material. Accuracies of ±10% can be obtained. Measurements have been made on several high melting oxides of interest in nuclear technology. The heat of fusion of UO_2 was found to be 25.3 kcal/mole and is believed to be the first directly measured value reported. The heat of fusion of Al_2O_3 was determined to be 21.4 kcal/mole; the $\alpha-\beta$ transition in BeO determined to be 0.95 kcal/mole. The technique employed is adaptable to broader studies on the phase diagrams of inorganic salts. The primary limitation of the method lies in the choice of inert container materials for the crucible and the maintenance of low thermal gradients in the material investigated. The most useful crucible material for these studies with oxides at high temperatures was W. (auth)

31499 PRESENT STATE AND FUTURE PROSPECTS OF THE THERMODYNAMICS OF FUSED SALTS. Murgulescu, I. G. (Physical Chemistry Inst., Bucharest). pp 91-154 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

The history and achievements in this field are reviewed. Data have been assembled for comparison (25 tables) and the juxtaposition of results from theoretical and empirical formulas, and experimental measurements enable comparisons to be made. Information and discussions are included on simple fused salts and fused salt mixtures. A summary indicates the outlook for this field. Information and data are also included on significant-structure theory, compressibility and thermal expansion coefficients, and heat capacities for liquid metals. 14 references. (auth)

31500 USE OF DISTRIBUTION MEASUREMENTS FOR DETERMINING THE ACTIVITY OF A SOLUTE IN MOLTEN SALT MIXTURES. Marcus, Y. (Hebrew Univ., Jerusalem); Zangen, M. pp 155-65 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

The thermodynamic activity of a solute in a molten salt or a molten salt mixture can, in principle, be determined from solubility measurements. Often, however, such data cannot be obtained, because of too large a solubility, or of the non-availability of macro quantities of the solute (e.g., compounds of the higher actinides). A solution of the solute in an immiscible liquid phase, even at trace concentrations, can be used instead of the pure solute in solid form. When the immiscible liquid has a constant composition, arrived at by extrapolation or interpolation of experimental data at several compositions, the comparison of distribution coefficients leads to a comparison of concentrations at a constant solute activity. Activities are still proportional to concentrations when only a trace constituent in this immiscible phase is varied. These distribution determinations provide data for the evaluation of primary activity coefficients and of secondary, "solvent effect" activity coefficients in the molten salt, with various molten salt mixtures being effectively different solvents. The temperature variation of the activity coefficients, hence the partial molal heat contents, can also be easily derived. Since the concentration of the solute can be varied in these experiments, the activity of the solvent salt can also be calculated from the Gibbs-Duhem relationship, provided significant concentrations of solute are used. This application, however, requires the knowledge of the activity of the solute in the immiscible phase, which is sometimes more easily attainable than for the molten salt. The method is illustrated by data obtained for mercury iodide as a solute, a high boiling hydrocarbon (m-terphenyl) as an immiscible liquid, and varied molten alkali nitrate mixtures as the molten salts. The activities of the solute obtained at several temperatures are compared with the predictions from theory, in particular the quasi-lattice and reciprocal Coulomb effect hypotheses. (auth)

31501 DETERMINATION OF EXCESS VOLUME IN THE SOLUTION Cd-$CdCl_2$ BY GAMMA ABSORPTION. Moscinski, J. (Institut de Technique Nucleaire, Krakow); Suski, L. pp 167-80 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968. (In Polish).

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

A trial of the use of gamma absorption measurements for determining excess volume in the course of dissolution of Cd in molten $CdCl_2$ is described. The method is based on a knowledge of the molar volumes of the solution components (given in the literature) and of the mass absorption coefficients for the monoenergetic gamma radiation (measured for the radiation source and equipment geometry). The operational method is described, and the effect of errors and of the various experimental parameters on the accuracy of the method is discussed. The excess volumes for the solution of Cd in its molten chloride at 900 to 1100°K show a non-linear variation with the molar fraction of the dissolved metal. These results are discussed on the hypothesis that the species Cd_2Cl_2 forms in the solution, a hypothesis with which most of the workers who have studied this system are in agreement. The excess volumes of the mixture $CdCl_2-Cd_2Cl_2$ are compared with the excess entropy of these solutions. (auth)

31502 HEATS OF MIXTURE IN BINARY SYSTEMS OF MOLTEN SALTS. Marchidan, D. I.; Telea, C. (Institut de Chimie Physique, Bucharest). pp 203-7 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968. (In French).

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

The heat of mixing represents one of the fundamental problems of the chemistry of molten salt mixtures and is governed by the size, charge, and structure of the ions making up the system. A high-temperature calorimeter was used to determine the heats of mixing for CsBr + CsCl; NaI + NaCl; and LiCl + KCl at various concentrations. The first system had a positive, the other two negative heats of mixing. (auth)

31503 HENRY'S LAW CONSTANT MEASUREMENTS FOR FISSION PRODUCTS ABSORBED IN SILICATES. Norman, J. H.; Winchell, P.; Staley, H. G.; Tagami, M.; Hiatt, M. (General Atomics Div., General Dynamics Corp., San Diego, Calif.). pp 209-25 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

For the purpose of understanding the process of fallout formation, studies were made on Cs and Rb of Henry's Law constants in $CaO-Al_2O_3-SiO_2$ melts as a function of vapor pressure and temperature. Diffusion data were obtained by low flow-rate transpiration techniques. (P.G.C.)

31504 DISORDER IN CUBIC URANIUM SESQUINITRIDE. Mueller, F.; Ragoss, H. (Kernforschungsanlage, Juelich, Ger.). pp 257-64 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

The deviation of cubic U_2N_3 from exact stoichiometry is discussed in terms of an imperfection model with interstitial N_i^- and positive holes as defects. The discussion is based on data for the equilibrium N pressure as a function of the U_2N_3 composition and the temperature. The data were obtained by using the isothermal decomposition method. (auth)

31505 TERNARY SYSTEM PLUTONIUM-CARBON-OXYGEN. Potter, P. E. (Atomic Energy Research Establishment, Harwell, Eng.). pp 337-69 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

The aspects of the Pu-C-O system considered are phase relationships, CO equilibrium pressures for the reactions occurring in the various phase fields, and evaporation from Pu monoxycarbides as a function of composition. The composition limits of the Pu monoxycarbide phase field together with the phases present in the neighboring fields have been determined at 1300 to 1500°C and the variation of cell size of the oxycarbide with composition determined. The phase fields were Pu + Pu monoxycarbide, Pu + βPu_2O_3 + Pu monoxycarbide, Pu monoxycarbide, PU_2C_3 + Pu monoxycarbide, βPu_2O_3 + Pu monoxycarbide, and βPu_2O_3 + Pu_2C_3 + Pu monoxycarbide. The phase boundary between single phase Pu monoxycarbide and Pu_2C_3 + Pu monoxycarbide is essentially coincident with the PuC-PuO line for compositions between ~$PuC_{0.9}O_{0.1}$, and $PuC_{0.62}O_{0.38}$, and over this range cell size decreases from ~4.982 Å to 4.969 Å. Between $PuC_{0.92}$ and ~$PuC_{0.9}O_{0.1}$ the cell size increases from 4.973 Å to 4.982 Å as vacancies are occupied. $PuC_{0.62}O_{0.38}$ represents the point of maximum O substitution in this region. Greater O substitution can occur in the presence of Pu metal, the limiting composition being ~$PuC_{0.27}\,O_{0.67}$ corresponding to a cell size of 4.958 Å. The constancy of the cell sizes found for Pu_2C_3 and βPu_2O_3 suggests that there is no solubility of O or C in these compounds. The equilibrium CO pressures for the reactions occurring in the various phase fields of the system have been calculated. CO pressures as a function of oxycarbide composition have been derived by assuming that PuC and the hypothetical compound, PuO, form ideal solid solutions. The thermal stability of Pu monoxycarbides has been examined at 1300 to 1550°C. The volatility increases with oxygen content up to maximum for a composition ~$PuC_{0.5}O_{0.5}$. The predominant vapor species are probably Pu and CO but for compositions with <25 at. % O some additional C may be removed in the gas phase. For the composition ~$PuC_{0.5}\,O_{0.5}$, the decomposition $\langle PuC_{0.5}\,O_{0.5}\rangle \rightarrow (Pu) + \frac{1}{2}\,(CO)$ is probably occurring; the measured enthalpy for this evaporation (1325 to 1450°C) was 150 ± 9 kcal $mole^{-1}$, compared with a theoretical value of 135 kcal $mole^{-1}$. For the oxycarbides with greater O contents the O removed could not be attributed solely to CO. (auth)

31506 PHASE FORMATION ACCOMPANYING THE INTERACTION OF TRANSITION METALS WITH CARBON IN FINE LAYERS. Babad-Zakhryapin, A. A.; Gert, L. M.; Rogozin, V. D. (Inst. of Energetic Physics, Obninsk, USSR). pp 427-34 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968. (In Russian).

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

A phase formation accompanying the interaction of transition metals with carbon in fine (20–50 μm) layers obtained by the condensation in vacuo (5×10^{-5} mmHg) of niobium, zirconium, tantalum, hafnium, and titanium vapors on the surface of graphite at 1500 to 2200°C is examined. The diffusion processes in such layers possess a number of specific features which can be used for growing compounds with a narrow homogeneity region. The various phases follow a certain sequence, depending on base layer temperature, supersaturation of the metal vapors and the time of layer formation. The occurrence of one or another phase in the layers is found to bear a definite relationship to the manner of obtaining the layers. Under certain conditions all the carbide phases indicated in this table for each system are observed simultaneously within the layers, and the corresponding metal is observed on the outer surface of the layer. Compounds of the type MeC_x are isomorphous with, and have a smaller lattice parameter than, known MeC carbides. From data concerning the dependence of the niobium carbide lattice parameter on carbon content for NbC_x it is found that $0.8 > x > 0.7$. In the system Ti–C compounds of the type MeC_x were not found. However, there is indirect evidence that the possibility of such a compound in this system cannot be excluded completely. The possible reasons for the occurrence of MeC_x compounds are discussed along with the relationship between the carbide properties and the possible existence of MeC_x compounds in the samples. (auth)

31507 THERMODYNAMICS OF INTERSTITIAL THREE-COMPONENT PHASES OF THE CARBOHYDRIDE TYPE. Andrievskii, R. A.; Kalinin, V. P.; Pepekin, G. I. (Inst. of Energetic Physics, Obninsk, USSR). pp 457-66 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968. (In Russian).

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

Using statistical thermodynamics, expressions are derived for the partial free energies and configurational entropies of three-component phases in which the metalloid atoms are arranged in octahedral and tetrahedral sublattices (of the same type as compounds in the systems $ZrC-ZH_2$ and $ZrN-ZrH_2$). Study of the nuclear magnetic resonance spectra of such compounds shows that the hydrogen atoms are arranged not only in tetrahedral but also in octahedral positions. The effects of hydrogen atom transitions from the tetrahedral to the octahedral sublattice on the partial configurational entropies of the carbon and hydrogen are investigated. The experimental values for the partial entropy of the hydrogen in zirconium carbohydride exhibit a positive deviation from configurational entropy. This deviation is discussed in the light of results obtained by measuring the magnetic and galvanomagnetic properties of carbo- and nitrohydrides. (auth)

31508 THERMODYNAMICS OF THE PLUTONIUM CARBIDES. Olson, W. M.; Mulford, R. N. R. (Los Alamos Scientific Lab., N. Mex.). pp 467-79 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

Thermodynamic quantities were determined for $PuC_{0.87}$ and $PuC_{1.5}$ by a partial Knudsen effusion technique. Supporting mass spectrometric measurements were made. The results were $PuC_{1.5}$: $\Delta H_T^0 = 93.01$ kcal/gfw, $\Delta S_T^0 = 20.09$ cal/°K gfw, and $PuC_{0.87}$: $\Delta H_T^0 = 87.6$ kcal/gfw and $\Delta S_T^0 = 24.26$ cal/°K gfw. Using Kruger and Savage's heat capacity data for $PuC_{0.87}$: $\Delta H_{298}^0 = -10.0$ kcal/mole, $\Delta S_{298}^0 = +3.5$ cal/°K gfw and the absolute entropy of plutonium monocarbide $\Delta S_{298}^0 = 18.2$ cal/°K gfw. (auth)

31509 METALLOGRAPHIC AND X-RAY INVESTIGATIONS IN THE Pu–O AND U–Pu–O SYSTEMS. Sari, C.; Benedict, U.; Blank, H. (EURATOM, Karlsruhe, Ger.). pp 587-611 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

The Pu–O system has been considered over the range $1.62 < O/Pu \leq 2.00$ with specimens prepared at 1500 to 1600°C by reducing PuO_2 pellets in hydrogen. The reduced samples were then quenched to room temperature and investigated by metallography and x-ray analysis. The results led to a modified Pu–O phase diagram showing an extended field of the α-phase between $1.62 < O/Pu \lesssim 1.69$ instead of the formerly accepted compound at O/Pu = 1.61 and a shift of the phase boundary for PuO_{2-x} from O/Pu = 1.98 to about 1.995. Published high temperature X-ray and EMF data are consistent with the modified phase diagram. In the U–Pu–O ternary diagram the disproportionation reaction $MO_2 + {} > O_2 = M'O_{2+x} + M''O_{2.66}$ established by Brett and Fox at 750°C has been investigated at 600, 1000, and 1400°C by metallography and x-ray analysis. This reaction does not occur at 600°C, but a metastable M_3O_7 phase is produced instead. An estimate on Pu diffusion can be made on the basis of the metallographic results. In the U–O system a modification of the phase diagram is proposed on the ground of a newly found order-disorder transformation in U_4O_9 near 600°C. (auth)

31510 TERNARY U–Ce–Zr OXIDES, NITRIDES, AND CARBIDES. Holleck, H.; Wagner, W. (Kernforschungszentrum, Karlsruhe, Ger.). pp 667-81 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968. (In French).

From Symposium on Thermodynamics of Nuclear Materials With Emphasis on Solution Systems, Vienna, Austria. See STI/PUB-162; CONF-670915.

Radiographic studies were carried out on the quasi-ternary systems $UO_2-ZrO_2-CeO_{2-x}$, UN–ZrN–CeN and UC–ZrC CeC within the scope of research on fission product solutions in fuel. The limits of solubility of $(Ce_y, Zr_{1-y})O_{2-x}$ in UO_2 were discussed for temperatures between 1600° and 1800°C. After the incorporation of trivalent Ce ions and O vacancies, the solubility of Ce in the mixed phase $(U, Ce, Zr)O_{2-x}$ is reduced whereas that of Zr is increased. At 1700° and 1800°C a monophase, cubic mixed crystal was observed up to 80 mole % ZrO_2. In the quasi-binary systems UN–CeN and UN–ZrN there are extensive domains of mixed crystals. In the Un–ZrN system it was not possible to obtain a homogeneous transition between 80 mole % UN and pure UN under the conditions examined. At 2000°C there was a small miscibility gap in the UN–CeN system, close to the composition 60 mole % UN. Solubility in the ZrN–CeN system is low. The solubility of CeC in the mixed phase (U_xZr_{1-x}) C is about 30 mole % for x = 1 (1500°C) and decreases when x and the temperature increase. (auth)

31511 HIGH PRESSURE HOT PRESSING OF OXIDES. Vahldiek, F. W.; Lynch, C. T. (Air Force Materials Lab., Wright-Patterson AFB, Ohio). pp 637-64 of Sintering and Related Phenomena. Proceedings of the International Conference, Univ. of Notre Dame. Kuczynski, G. C.; Hooton, N. A.; Gibbon, C. F. (eds.). New York, Gordon and Breach, Science Publishers, 1967. See CONF-650644.

Fine particle zirconium oxide and hafnium oxide with and without stabilizing additives have been subjected to pressures of 3.8 to 30 kbars at temperatures up to 1700°C in a specially designed high pressure cell. Simultaneously measurements of resistance and temperature were made under pressure. Submicron refractory oxides were formed into hard, dense high purity bodies with uniform grain shapes and 1 to 10 μ average grain size. On the unstabilized bodies electrical resistance measurements provided information on the effects of pressure on the monoclinic-tetragonal phase transformation. To reach densities above 99% theoretical, a cyclic application of pressure and temperature with increasing pressure was used. The grain size varied from a maximum at the outer edge of the specimen to a minimum size at the center where the pressure was effectively greatest. Zirconium oxide pressed at 3.8 to 30 kbars at 1700°C had virtually theoretical density and a grain size of 4 to 6 μ at the center of 10 to 12 μ at the outer edge of a ¼ inch diameter specimen. Zirconium oxide at 3.8 to 10 kbars at 1700°C had a density of 99%, inner grain size of 4 μ and outer grain size of 10 μ. Zirconium oxide pressed at 3.8 to 10 kbars at 1300°C had a density of 90% with a 2 μ inner and 4 μ outer grain size. Compared with zirconium oxide, hafnium oxide reached high densities under similar conditions at lower pressures. During the high pressure sintering of pure zirconium oxide a decrease in temperature of the monoclinic-tetragonal phase transition was observed with increasing pressures with an approximate slope of $dT/dP = -0.01°$ per bar. Electron micrographs indicate the maximum stress which occurs is at the center of the specimens. (auth)

31512 SINTERING KINETICS OF TUNGSTEN TRIOXIDE. Aitken, E. A. pp 793-805 of Sintering and Related Phenomena. Proceedings of the International Conference, Univ. of Notre Dame. Kuczynski, G. C.; Hooton, N. A.; Gibbon, C. F. (eds.). New York, Gordon and Breach, Science Publishers, 1967.
See CONF-650644.

The shrinkage of tungsten trioxide during the initial stage of sintering is nearly a linear function of time with an activation energy for the process of 52 kcal. Because of the ease with which domain growth can occur by applied stress, the shrinkage is thought to result from movement of domain walls. The viscous flow model proposed by Frenkel, however, also gives the same time dependence. Grain growth appears to be normal for the conditions used. The porosity is located intergranularly, redistributing itself with continued annealing to form large pores. The pores do not appear to be stabilized by trapped gases. (auth)

31513 SINTERING OF OXIDES AND SULFIDES. White, J. (Univ. of Sheffield, Eng.). pp 245-72 of Sintering and Related Phenomena. Proceedings of the International Conference, Univ. of Notre Dame. Kuczynski, G. C.; Hooton, N. A.; Gibbon, C. F. (eds.). New York, Gordon and Breach, Science Publishers, 1967.
See CONF-650644.

Transport processes considered as contributing to the observed configurational changes are viscous flow, plastic flow, evaporation-condensation, volume diffusion, and surface diffusion. Evaporation-condensation and surface diffusion can account for neck growth and for changes in pore shape but not for the decrease in the distance between particle centers and densification. When they occur they may have an inhibiting effect on densification in the initial stage of sintering. The remaining processes could account for both neck-growth and densification. Sintering models using geometry and equations are discussed and previous data applied. Alumina was used in an investigation testing the sintering of oxides theories and predictions. (J.C.W.)

31514 MICROSTRUCTURE IN OXIDES. Vasilos, T. (Avco Corp., Wilmington, Mass.); Spriggs, R. M. pp 301-27 of Sintering and Related Phenomena. Proceedings of the International Conference, Univ. of Notre Dame. Kuczynski, G. C.; Hooton, N. A.; Gibbon, C. F. (eds.). New York, Gordon and Breach, Science Publishers, 1967.
See CONF-650644.

The microstructure features of grains and degree of densification that develop in single phase ceramic oxides have been shown to be a strong function of processing conditions. Isometric grain shapes result from normal sintering or hot pressing procedures, while hot working methods such as extrusion and press forging have been shown to provide grain structure with significant preferred orientation and grain elongation. While full density in pure single phase polycrystalline oxides can be achieved by both sintering and hot forming methods, the latter is shown to offer advantage of grain size control, particularly in the finer size range. (auth)

31515 REACTIONS IN THE $SrO-B_2O_3-Nd_2O_3$ AND $SrO-B_2O_3-Ho_2O_3$ SYSTEMS AT 1100°C. Dzhurinskii, B. F.; Tananaev, I. V.; Aliev, O. A. (Inst. of General and Inorganic Chemistry, Moscow). Izv. Akad. Nauk SSSR, Neorg. Mater., 4: 734-7(May 1968). (In Russian).

Isothermal saturation method was used for determining phase equilibriums in $SrO-B_2O_3-Nd_2O_3$ and $SrO-B_2O_3-Ho_2O_3$ systems. Phase equilibrium diagrams were constructed for the above systems at 1100°C. The solid phases of $NdBO_3$, $Nd(BO_2)_3$, and $HoBO_3$ were separated and analyzed. Stratification was observed in systems adjoining B_2O_3. (R.V.J.)

31516 CONSTITUTION OF TERNARY Ta-Mo-C ALLOYS. Rudy, Erwin; Brukl, C. E.; Windisch, Stephan (Aerojet-General Corp., Sacramento, Calif.). J. Amer. Ceram. Soc., 51: 239-50(May 21, 1968).

The ternary system Ta-Mo-C was investigated by x-ray, melting point, DTA, and metallographic methods on chemically and thermally characterized specimens; a phase diagram for temperatures from 1500°C through the melting range was established. At high temperatures, the cubic monocarbides, TaC and α-MoC_{1-x}, as well as the hexagonal subcarbides, Ta_2C and Mo_2C, form continuous series of solid solutions. Below 1960°C, the homogeneity range of the B1 phase is temperature-dependent. At 2230°C, the ternary subcarbide solid solution disproportionates into metal and monocarbide alloys. The sublattice order-disorder transformation temperatures in both subcarbides are lowered by the mutual exchange. The ternary range of the η-MoC_{1-x} phase is very restricted, and the metastable ζ-Ta-C phase is stabilized in the ternary. Seven isothermal reactions occur in the system in the range from melting to 1500°C; two further isotherms between 1400 and 1500°C are indicated to result from the order-disorder transition in Mo_2C. Using existing literature data for the thermodynamic properties of the binary carbides, the phase relations in the Ta-Mo-C system were thermodynamically analyzed. The calculated equilibria are in good agreement with experimental observations. (auth)

31517 MELTING RELATION IN THE SYSTEM TiO_2-WO_2. Chang, Luke L. Y. J. Amer. Ceram. Soc., 51: 295(May 21, 1968).

Results from quenching experiments b/w 1400 and 1700°C are plotted on a binary diagram. The liquidus temperature increases with TiO_2 content from the 85% WO_2 point. A minimum point exists at 1505°C and 85% WO_2. At 1530°C and 89% WO_2, four phases (W, WO_2, $W_{18}O_{49}$, and liquid) are in equilibrium. (D.L.C.)

31518 SYNTHESIS OF RHENIUM DITELLURIDE. Sorrell, Charles A. (Miami Univ., Oxford, Ohio). J. Amer. Ceram. Soc., 51: 285-6(May 21, 1968).

A single phase, $ReTe_2$, formed between 450 and 935°C in sealed, evacuated fused silica tubes. The compound may be indexed on a triclinic unit cell, but an unequivocal unit cell cannot be chosen without single-crystal x-ray data. The compound dissociates at 935 ± 5°C in sealed tubes to solid rhenium and liquid tellurium with a high vapor pressure. No ternary compounds are found in the system Re-Pb-Te. (auth)

31519 FORMATION OF FULLY DENSE OXIDES BY PRESSURE CALCINTERING OF HYDROXIDES. Morgan, P. E. D.; Scala, E. (Cornell Univ., Ithaca, N. Y.). pp 861-94 of Sintering and Related Phenomena. Proceedings of the International Conference, Univ. of Notre Dame. Kuczynski, G. C.; Hooton, N. A.; Gibbon, C. F. (eds.). New York, Gordon and Breach, Science Publishers, 1967.
See CONF-650644.

Densifying ceramics with the aid of dehydration, decarbonation, and other phase changes allows the use of lower temperatures, pressures and/or time to achieve very highly dense and translucent products. A very fine grain size can be retained, with resultant high strengths. The process is divided into two main stages, one involving a massive phase change and compaction process during decomposition, and second an activated hot-pressing of the newly formed oxide material leading to theoretical density. (auth)

31520 ELECTRON-DIFFRACTION STUDY OF TANTALUM DIOXIDE IN THIN FILMS. Khitrova, V. I.; Klechkovskaya, V. V.; Pinsker, Z. G. (Inst. of Crystallography, Moscow). Sov. Phys.-Cryst. (Engl. Transl.), 12: 907-12(May-June 1968).
Translated from Kristallografiya, 12: 1044-50(Nov.-Dec. 1967).

A tetragonal phase with identity periods of a = 13.32, c = 6.12 Å was detected in the Ta-O system by electron diffraction. The structure contains 96 atoms and is described by 18 parameters in the $I4_1/a$ space group. Analysis of several samples showed that the phase in question had a variable composition expressed by the formula $32(TaO_{2-x})$, where $0 \leq x < 1$. Different tantalum oxide samples have widely differing arrangements of the constituent atoms and this leads to the formation of crystal lattices with different types of chemical bonds. (auth)

31521 TERNARY COMPOUNDS IN THE Zr-H-C AND Zr-H-N SYSTEMS. Andrievskii, R. A.; Boiko, E. B.; Kalinin, V. P. Sov. Phys.-Cryst. (Engl. Transl.), 12: 930-1(May-June 1968).
Translated from Kristallografiya, 12: 1068-70(Nov.-Dec. 1967).

Syntheses of Zr carbo- and nitrohydrides were made in a H medium at 1000°C. Lattice parameters were determined, and calculated x-ray line intensities agree well with experimental results. The compounds (approximate composition, $ZrC_{0.3}H$ and $ZrN_{0.4}H$) may be assigned to the space group $P6_3/mmc$; the c/a ratio is close to the theoretical ratio for the hexagonal close-packed lattice. Comparison with literature data indicates wide ranges of homogeneity. Electric resistivity measurements on sintered samples were quite large, around 1000 $\mu\Omega \cdot cm$, indicating a defective structure. (D.L.C.)

31522 X-RAY PHASE ANALYSIS OF THE ERBIUM-HYDROGEN SYSTEM. Azarkh, Z. M.; Gavrilov, P. I. Sov. Phys.-Cryst. (Engl. Transl.), 12: 932-4(May-June 1968).

Translated from Kristallografiya, 12: 1070-2(Nov.-Dec. 1967).

Er samples were saturated with H gas, held at 800°C for 1 hr, and studied by x-ray diffraction. Metallic Er exhibits hexagonal structure with a = 3.557 Å and c = 5.584 Å. At ≥7 at. % H, a cubic phase appears; between 66 and 68 at. % H (ErH_2), there is a narrow homogeneous range of the cubic β-phase with a = 5.125 Å. At ≥68.5 at. % H, another new phase appears, completely displacing the β-phase at 73 to 75 at. % H (ErH_3). This γ-phase belongs to the rhombic system, with a = 6.253 Å, b = 6.498 Å, and c = 7.230 Å. The results are compared with literature for other lanthanide hydrides. (D.L.C.)

31523 STUDY OF HIGHER SULFIDES OF THE LANTHANIDES AND THE ACTINIDES. Marcon, J.-P.; Pascard, R. (CEN, Fontenay-aux-Roses, France). Rev. Int. Hautes Temp. Refract., 5: 51-4(Jan.-Mar. 1968). (In French).

In this study of mixed sulfides having a $(U, X)_xS_y$ formula, where X = Ce, Gd, and Pu, the analogy of behavior of Pu and ceric rare earth metals with sulfur is demonstrated. This analogy is attributed to the peculiar stability of the ion Pu^{3+}. The transformations M_2S_3 $\alpha \rightarrow \beta \rightarrow \gamma$ were studied especially, and it is concluded that probably only β and γ are polymorphous compounds. The structure of CeS_2 is described, which is the typical structure of polysulfides and polyselenides of the lanthanides and of plutonium. (auth)

31524 PHASE CORRELATION IN THE SYSTEMS FORMED BY OXIDES OF RARE EARTHS AND OXIDE OF CHROMIUM. Tresvyatskii, S. G.; Lopato, L. M.; Pavlicov, V. N.; Shevchenko, A. V. (Inst. of Cermets and Special Alloys, Kiev). Rev. Int. Hautes Temp. Refract., 5: 45-50(Jan.-Mar. 1968).

The study was done on systems $R_2O_3-Cr_2O_3$ with R = La, Nd, Sm, Eu, Gd, Y, and Sc. The $RCrO_3$ compounds which have been identified in these different systems and who have a perovskite-type structure, were studied, between 20 and 1,000°C, by differential thermal analysis, high temperature dilatometry, and microscopy. These different methods showed a reversible transformation for the lanthanum chromite, and also the existence of a new phase called γ in the system $Sc_2O_3-Cr_2O_3$. This study of rare-earth chromites includes also density, microhardness, and refraction index measurements, and also infrared spectroscopy realized on single crystals. (auth)

31525 THERMALLY ACTIVATED DEFORMATION IN DILUTE ZIRCONIUM-OXYGEN ALLOYS. Das Gupta, P.; Arunachalam, V. S. (Bhabha Atomic Research Centre, Bombay). J. Mater. Sci., 3: 271-81(May 1968).

The effects of temperature and strain-rate on the yield and flow stress of zirconium, containing oxygen in the range of 0.09 to about 2.5 at. % was examined at temperatures between 77 and 700°K. The measurements were coupled with strain rate change tests and stress-relaxation experiments, so that all the deformation parameters associated with thermal activation could be evaluated. The results of these measurements showed that the thermal component of flow stress increases with increasing oxygen content of the alloy. Two stages of activation were found to occur for all these alloys. The first stage was associated with the unpinning of dislocation loops from impurity pinning points. At higher temperatures, because of the unpinning of many impurity pinning points, a second stage of activation associated with a different mechanism was found to occur. The variation of certain parameters associated with this stage of deformation strongly suggests the Peierls-Nabarro force as the controlling criterion. (auth) (UK)

Radiation Effects

Refer also to abstracts 32743, 32970, and 32973.

31526 (GEAP-4469) EXPERIMENTAL STUDIES OF TRANSIENT EFFECTS IN FAST REACTOR FUELS. SERIES III. PRE-IRRADIATED MIXED OXIDE (PuO_2-UO_2) IRRADIATIONS. FINAL REPORT. TRANSIENT IRRADIATIONS. Hanson, J. E.; Field, J. H. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). July 1967. Contract AT(04-3)-189. 168p. Dep. CFSTI.

Results of an experimental program to evaluate the performance of pre-irradiated fast ceramic reactor fuel under conditions simulating accidental power excursions are presented. Results from three experiments in the TREAT facility using 0.250-inch OD., type-347 stainless steel cladding, 28 weight percent PuO_2-72 weight percent UO_2 fuel specimens are interpreted with regard to fuel and cladding temperatures, fuel relocation, fission gas release, and cladding integrity. The transient failure threshold for axially unrestrained fuel at ~70,000 MWd/te (metric tonne.) was identified at ~50 volume percent molten fuel. The primary mechanism for this transient failure was identified as internal pressure caused by the sudden local release of contained fission gas during the excursion. (auth)

31527 EFFECT OF TYPE AND CONCENTRATION OF FUEL ON THE VOID VOLUME IN ALUMINUM DISPERSION-TYPE FUEL PLATES. Martin, M. M.; Erwin, J. H.; Martin, W. R. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 107-8(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31528 CONSIDERATIONS OF THE NATURE AND IMPORTANCE OF THE UO_2-CAN DISTANCES ON IRRADIATION. Mestdagh, G.; Flipot, A. J.; Smolders, A. (Centre d'Etudes Nucleaires, Mol, Belg.). J. Nucl. Mater., 26: 300-6(1968). (In French).

In order to evaluate the influence of the filling gas and the radial distance between fuel and can in sintered UO_2 base fuel elements, short-time irradiation experiments were done using a rabbit at a power of about 650 to 700 W/cm. The results show that without preceding special degassing the use of a filling gas has no noticeable effect and that the radial distance between fuel and can influences the temperatures distribution in the core of the fuel. (auth)

31529 FORMATION AND BEHAVIOUR OF GAS BUBBLES IN A NON-UNIFORM TEMPERATURE ENVIRONMENT. Eyre, B. L.; Bullough, R. (Atomic Energy Research Establishment, Harwell, Eng.). J. Nucl. Mater., 26: 249-66(1968). (AERE-R-5506).

Irradiation of uranium- and plutonium-based fuels results in the accumulation of fission products of which about 10% are the inert gases xenon and krypton. These gas atoms are insoluble and precipitate in the matrix to eventually form gas bubbles. The nucleation and subsequent behavior of the gas bubbles in a nonuniform temperature environment are considered. It is therefore particularly relevant to ceramic fuels in which steep temperature gradients are typically present during operation. A homogeneous nucleation model is used to describe the formation of the gas atom clusters during irradiation. It is shown that the scale of nucleation is a function of temperature, and thus in a temperature gradient the distribution of nuclei is nonuniform. The subsequent growth of the nuclei to form gas bubbles leads to the development of nonuniform swelling stresses. The gas bubbles are subjected to forces resulting from the temperature and stress gradients, which tend to drive them up the gradients. They are also subjected to restraining forces applied by structural heterogeneities. These forces, and in particular the stress gradient driving force, and the interaction between a bubble and a dislocation are considered. Energies involved in the process of coalescence between bubbles that collide are also considered. It was concluded that during irradiation when a large supersaturation of vacancies is present, the energy gained by the matrix from the vacancies absorbed into the bubble provides the dominant driving force for growth. The theory was applied to a uranium carbide pellet operating under a specific set of conditions typical of those existing in a fast reactor environment. Up to 10% burnup the predicted swelling is consistent with the values estimated from experiments. (auth)

Plastics and Other Materials

Refer also to abstracts 30812 and 31440.

31530 CRYSTALLIZATION OF AMORPHOUS GERMANIUM BY REACTOR NEUTRONS. Cox, C. M.; Wilsdorf, H. G. F. (Univ. of Virginia, Charlottesville). Trans. Amer. Nucl. Soc., 11: 158(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31531 EFFECT OF X RAYS ON THE GROWTH OF $CuSO_4$ CRYSTALS FROM AQUEOUS SOLUTION. Abdullaeva, Ya. S.; Gumanskii, G. A. (Tashkent State Univ.). Sov. Phys.-Cryst. (Engl. Transl.), 12: 967(May-June 1968).

Translated from Kristallografiya, 12: 1099(Nov.-Dec. 1967).

The growth of $CuSO_4$ crystals was studied under x-irradiation and control conditions, with thermistor-equalized temperature changes. Saturated solutions were slowly cooled, and the x-ray equipment was turned on near the nucleation temperature, with a dose of 14,400 R/hr at 40 kV. After 1 hr of irradiation, the crystals were recovered and the remaining solutions held for 24 hr. The following results were obtained: weight of crystals from the irradiated solution was larger by 19.5%. The crystals grown in the irradiated solution were large and weakly connected, while those without irradiation were small and in one large mass. The fraction of regular crystals was larger in the irradiated solution. In the solutions held for 24 hr, a few large regular crystals were formed in the irradiated solution, while in the other solution there were many small crystals. The water of crystallization content was the same in both types of crystals. (D.L.C.)

PHYSICS (GENERAL)

Astrophysics and Cosmology

Refer also to abstracts 31620, 31635, 31664, 31669, 31695, 31715, and 31722.

31532 (D-1-82-0702) SOLAR MODULATION CONTROL OF HIGH-LATITUDE RADIO-STAR SCINTILLATIONS AND IONOSPHERIC ABSORPTION. Lansinger, J. M. (Boeing Scientific Research Labs., Seattle, Wash. Geo-Astrophysics Lab.). Feb. 1968. 27p. Dep.

The relationship between high-latitude radio-star scintillation data and riometer ionospheric absorption was investigated. A lead/lag correlation analysis was made of the relationship between these geophysical data and solar data consisting of 10.7-cm radio flux, sunspots, and flare index. A statistically significant modulation control was observed to exist between solar activity and the high-latitude absorption and angular scintillation data. The terrestrial data have a tendency to peak some 20 to 30 days following solar activity. (auth)

31533 COMPOSITIONAL ANALYSIS OF LUNAR AND PLANETARY SURFACES USING THERMAL-NEUTRON-CAPTURE GAMMA RAYS. Reed, J. H.; Mandler, J. W. (Illinois Inst. of Tech., Chicago). Trans. Amer. Nucl. Soc., 11: 19-20(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31534 AN ESTIMATE OF THE PROMPT PHOTON SPECTRUM ARISING FROM COSMIC-RAY BOMBARDMENT OF THE MOON. Armstrong, T. W.; Alsmiller, R. G. Jr. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 20-1(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31535 NUCLEAR REACTIONS FOR THE STUDY OF SOLAR FLARE PROTONS. Rayudu, G. V. S. (Carnegie Inst. of Tech., Pittsburgh). Trans. Amer. Nucl. Soc., 11: 21-2(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31536 STELLAR ACCRETION AND X-RAY SOURCE. Sakashita, Shiro (Hokkaido Univ., Sapporo). Progr. Theor. Phys. (Kyoto), 39: 235-6(Jan. 1968).

An accretion model of the Scorpius x-ray source based on the gas-dynamical theory of accreting gas flow was investigated and it is shown that the existence of a standing shock wave in the accreting gas flow may play an important role. (W.D.M.)

31537 EVOLUTION OF CARBON STARS. I. GRAVITATIONAL CONTRACTION AND ONSET OF CARBON BURNING. Murai, Tadayuki (Kyoto Univ.); Sugimoto, Daiichiro; Hoshi, Reiun; Hayashi, Chushiro. Progr. Theor. Phys. (Kyoto), 39: 619-34(May 1968).

The evolution of carbon-oxygen stars in a gravitational contraction phase was studied with an automatic computation method for the stellar masses $0.7M_\odot$, $1.0M_\odot$, $2.6M_\odot$, and $10M_\odot$. These stars are regarded as representing the carbon-oxygen cores which have been formed in evolved stars in helium-burning phase. Computations were made for the two alternative cases, i.e., the cases with and without neutrino production. It was found that if nuclear burning is neglected, the central temperature increases without limit for the stars of $2.6M_\odot$ and $10M_\odot$, while it has an upper limit due to the onset of electron degeneracy for the stars of $0.7M_\odot$ and $1.0M_\odot$. The neutrino loss suppresses the increase of the central temperature and reduces the time scale of contraction. The onset stage of carbon burning and the subsequent transition to the zero-age carbon main-sequence stage were computed. The minimum stellar mass for this onset was found to be $0.75M_\odot$ for the case without neutrinos and $1.06M_\odot$ for the case with neutrinos. (auth)

31538 SPECTRAL SHIFT OF LIGHT RAYS EMITTED FROM A PULSATING OBJECT. Nariai, Hidekazu; Tomita, Kenji; Hayakawa, Mizuaki (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto), 39: 601-18(Mar. 1968).

As a sequel to previous papers on a bouncing or pulsating relativistic fluid sphere, the spectral shift z of light rays which are emitted from the surface of the pulsating sphere and received by a distant observer at rest in the exterior Schwarzschild region is discussed. The relation between z and the observer's proper time τ is numerically analyzed for various models corresponding to different sets of four parameters, (M, e, S_1, S_2), which specify the total mass, the degree of nonhomogeneity of the density distribution, and the minimum and maximum sizes of the pulsating object, respectively. The relation between the period-density and the adiabatic exponent is also examined in connection with Eddington's pulsation theory of variable stars. (auth)

31539 SUMMARY OF DAILY OBSERVATIONAL RESULTS OF SOLAR PHENOMENA, COSMIC RAY, GEOMAGNETIC VARIATION, IONOSPHERE, RADIO WAVE PROPAGATION, AND AIRGLOW DURING JANUARY THROUGH JUNE 1967. Rep. Ionosphere Space Res. Jap., 21: 247-56(Dec. 1967).

The diagrams illustrate the summary of daily observational results of solar phenomena, cosmic ray, geomagnetic variation, ionosphere, radio wave propagation, and airglow observed in Japan from January through June 1967. (M.O.W.)

31540 DEVELOPMENT OF SOLAR FLARES AND THE ACCELERATION OF SOLAR COSMIC RAYS. Sakurai, Kunitomo (Kyoto Univ.). Rep. Ionosphere Space Res. Jap., 21: 213-22 (Dec. 1967).

There are two ways in which solar flares can develop. This is concluded from an analysis of the generation of energetic particles and radio bursts associated with solar flares. One is an explosive development, and the other, gradual. The efficiency of particle acceleration of the former is very high compared with that of the latter. In consequence, some significant difference between the two types of flares with respect to the energy of accelerated particles and dynamic structure of solar radio bursts is deduced. There seem to be two ways in which instability can grow in the structure of sunspot magnetic fields, although triggering mechanism is the same. One is of an explosive nature, and the other gradual. It is inferred, consequently, that the efficiency of particle acceleration depends on the rate of space-time change in sunspot magnetic fields in the flare region. (auth)

31541 EFFECT OF SOLAR FLARE ON COSMIC-RAY INTENSITY. Mangal, Sain. J. Inst. Telecommun. Eng., 12: 352-62(1966).

An analytical study of effect of a solar flare on the cosmic-ray intensity in relation to the sudden increase in the longwave signal from Radio Tashkent on 164 kc monitored at Delhi was made. A good correspondence was found to exist between the two effects for a number of cases. (Indian Sci. Abstr.)

31542 DYNAMICS OF THE COLLISIONLESS GRAVITATING SYSTEMS. Marochnik, L. S. (Dushanbe Inst. of Astrophysics, USSR). pp 174-82 of Problema Mnogikh Tel i Fizika Plazmy. Bonch-Bruevich, V. L. Moscow, Izdatel'stvo Nauka, 1967. (In Russian).

Stellar systems are described by the model of the particle gas in the self-consistent gravitational field. Collective phenomena are considered by the Boltzmann equation and the Poisson equation for a gravitational potential. The linear approximation is considered. Collisionless anisotropic hydrodynamic equations for rotating stellar systems are formulated on the basis of the analogy between the Lorentz and the Coriolis force. The equations obtained are similar to those of collisionless magnetohydrodynamics. The evolution of rotating stellar systems (the Galaxy, galactic clusters, etc.) can be considered on the basis of these equations. The equations of a stellar "gas" are different in the direction of the axis of rotation and in the galactic plane. Gravitational instability is considered on the basis of the equations obtained. The relaxation time of the stellar systems (from observations) is of the order $T_r < T_a \approx 10^{10}$ years, where T_a is the age of the system. The relaxation time with the allowance for the star-star "collisions" is $T_r \gg T_a$. This paradox is solved by the following hypothesis: the entropy increase in the Galaxy, where the star-star "collisions" are practically absent, may be due to collective phenomena—nonlinear wave interactions. This shortens the relaxation time in the Galaxy to a value which is less than its age. A distribution of peculiar velocities of the stars which sets in must be anisotropic. The velocity dispersion in the galactic plane is always greater than the dispersion in the direction of the axis of rotation. This fact is confirmed by the observations. Anisotropic distribution is due to the constancy of the adiabatic invariant $\epsilon_\perp/\Omega$, where Ω is an angular velocity. (auth)

31543 DEPENDENCE OF NUCLEOSYNTHESIS ABUNDANCE CALCULATIONS ON THE MASS LAW. Seeger, Philip A. Ark. Fys., 36: 495-508(1967).

A qualitative model of the r process (i.e., stellar nucleosynthesis by neutron capture on a rapid time scale) is presented. A semiempirical mass law is used to estimate neutron binding energies and beta-decay probabilities for isotopes which are as much as 50 mass units heavier than the valley of beta stability. Peaks in the solar-system isotopic abundance curve indicate the influence of shell-structure magic numbers in these heavy isotopes; simple parabolic terms in the mass law, if determined independently from deformations, have been found adequate to reproduce the observed abundances. However, it is found that additional mass law terms which greatly improve the fit to known masses near beta stability, often override the shell-effects terms in the super-heavy region, and destroy the calculated abundance peaks. Several examples of mass laws and the resulting abundance calculations are considered. (auth)

31544 DISCOVERY OF A NEW SPECTROSCOPIC BINARY: 16 PISCIUM. Cayrel de Strobel, G. (Centre National de la Recherche Scientifique, Paris). Astrophys. Lett., 1: 173-5 (May 1968).

The dFO star (m_v = 5.6) 16 Piscium was found to be a double lined spectroscopic binary from a set of 13 spectra taken with a dispersion of 9.7 Å/mm with the coude spectrograph of the Haute-Provence Observatory. An attempt to calculate the preliminary elements of the orbit of the binary was made. (auth)

31545 EFFECT OF SATURATION ON ZEEMAN TRIPLETS. Moe, O. Kjeldseth; Maltby, P. (Univ., Olso). Astrophys. Lett., 1: 189-91(May 1968).

The connection between the shape of the line profile and the line intensity was investigated for a Zeeman triplet. Theory and observation were compared for the case of sunspot spectra. Application of the theory to the spectra of magnetic stars is also briefly discussed. (auth)

31546 ELECTRON TEMPERATURES OF THE ORION NEBULA AND NGC 2024. II. OBSERVATIONS OF THE RADIO RECOMBINATION LINES. Mezger, P. G.; Ellis, S. A. (National Radio Astronomy Observatory, Green Bank, W. Va.). Astrophys. Lett., 1: 159-65(May 1968).

The H 109α radio recombination line emission was observed in a grid of points over the Orion Nebula using the 140-foot telescope of the National Radio Astronomy Observatory. In this way contour maps of electron temperature and radial velocity were obtained. The electron temperature varies between 5000 and 8500°K, with a plateau at about 6800°K in the center and a shell-like structure of higher temperature around it. (auth)

31547 ELECTRON TEMPERATURES OF THE ORION NEBULA AND NGC 2024. I. RADIO OBSERVATIONS OF THE FREE-FREE CONTINUUM. Terzian, Yervant (Cornell Univ., Ithaca, N. Y.); Mezger, P. G.; Schraml, J. Astrophys. Lett., 1: 153-8(May 1968).

The Orion Nebula and NGC 2024 were observed at various frequencies at the National Radio Astronomy Observatory and the Arecibo Ionospheric Observatory. The fluxes obtained were used to compute a spectrum from which the electron temperatures of the H(II) regions were derived. The best isothermal temperatures were found to be 3000°K for the Orion Nebula and 4000°K for NGC 2024. (auth)

31548 FEELING THE PULSAR'S PULSE. Stubbs, Peter. New Sci., 38: 330-3(May 16, 1968).

Within less than three months of their announcement the mysterious pulsing radio sources discovered at Cambridge have provoked a flood of contradictory theories. As yet no explanation is entirely satisfactory. A short discussion on the properties of pulsers is given. (auth) (UK)

31549 HYPOTHESIS FOR ABSENCE OF LUNAR BOW AND WAKE SHOCK WAVES. Dryer, Murray (Environmental Science Service Administration, Boulder, Colo.). J. Geophys. Res., 73: 3583-4(June 1, 1968).

The idea of continuum flow was implicit in Gold's (1966) suggestion of compressed interplanetary magnetic field lines that produce a bow shock. Michel's (1967) suggestion explicitly requires continuum flow with the boundary condition on the sunlit hemisphere, such that all solar wind particles that flow through an area with a diameter equal to that of the Moon, are absorbed in the surface. This Letter proposes an alternative qualitative model that starts with consideration of the usual continuum flow, deflected around the sunlit side, but with the final observation that consideration of certain scale lengths requires the interaction mechanism to be considered as "free particle" dynamics. (W.D.M.)

31550 IDENTIFICATION OF THE FORBIDDEN S_I LINE $3p^4$ $^3P_2-3p^4$ $^1D_2$ IN THE FRAUNHOFER SPECTRUM. Swensson, J. W. (Univ., Lund, Sweden. Univ., Liege). Astrophys. Lett., 1: 185-7(May 1968).

A weak absorption line at λ10821.2 in the solar spectrum has been ascribed to the forbidden transition $3p^4$ $^3P_2-3p^4$ $^1D_2$ of S(I). The relative weakness of the observed line suggests that the photospheric sulfur abundance derived by Goldberg, Mueller, and Aller is too high by about 0.2 in the logarithm. (auth)

31551 INFLUENCE OF THE IONIZED MEDIUM ON SYNCHROTRON EMISSION OF INTERMEDIATE ENERGY ELECTRONS. Ramaty, Reuven (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 73: 3573-82(June 1, 1968).

The suppression of synchrotron emission at low frequencies, owing to the influence of the ionized medium, was investigated. Explicit expressions and detailed numerical values of the emission spectra are presented for various electron energies and plasma and cyclotron frequencies. Unlike previous studies of this suppression effect, which were applicable only to ultrarelativistic electrons, the present treatment is valid for electrons of arbitrary energies and in particular for intermediate energy electrons such as those presumably accelerated in solar flares. (auth)

31552 LITHIUM IN SUNSPOTS. Wiehr, E.; Stellmacher, G.; Schroeter, E. H. (Univ., Goettingen, Ger.). Astrophys. Lett., 1: 181-4(May 1968).

The intermediate strength absorption line at λ 6707.82 has been identified from high-dispersion sunspot spectra with the Li resonance doublet. The identification is based on wavelength measurements that use the scale of international Fe- and Ne-wavelength standards, and on an analysis of the Zeeman pattern of the line. A reinvestigation of Li abundance leads to a value of log N_{Li} = 0.76 ± 0.2 when log N_H = 12.00. The isotope ratio $^6Li/^7Li$ is probably less than 0.1; an unidentified blend in the red wing of the line prohibits a more accurate determination of this ratio. (auth)

31553 MICROWAVE ABSORPTION LINES FROM DIELECTRONIC RECOMBINATION OF HIGHLY IONIZED ATOMS. Sunyaev, R. A. (Inst. of Applied Mathematics, Moscow); Vainstein, L. A. Astrophys. Lett., 1: 193-4(May 1968).

The process of dielectronic recombination is expected to give a very high overpopulation of levels with large principal quantum number n: $b(n) \gg 1$. The function b(n) begins to decrease from some value $n = n_\nu$ or n_e due to photoionization by background radiation or electronic collisions. At these values of n absorption lines connected with transition to neighbor levels may appear in the microwave region. The optical depth of such lines of the solar corona is estimated to be of the order of 10^{-2}. It is possible that these lines may be observed in the solar absorption spectrum. (auth)

31554 PARKES 2134 + 004: A QUASI-STELLAR OBJECT WITH A VERY UNUSUAL RADIO SPECTRUM. Shimmins, A. J. (CSIRO, Sydney); Searle, L.; Andrew, B. H.; Brandie, G. W. Astrophys. Lett., 1: 167-9(May 1968).

The spectrum of the radio source Parkes 2134 + 004 is described. The spectrum is curved upwards and has a peak flux density of 13 flux units at a frequency of 6,000 MHz. The radio source is identified with a quasi-stellar object. (auth)

31555 PERTURBATIONS OF THE INTERPLANETARY MAGNETIC FIELD BY THE LUNAR WAKE. Ness, N. F.; Behannon, K. W.; Taylor, H. E.; Whang, Y. C. (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 73: 3421-40(June 1, 1968).

Detailed measurements of the interplanetary magnetic field in the vicinity of the Moon have been performed on the Explorer 35 selenocentric spacecraft launched July 1967. The observational evidence fails to reveal the existence of a lunar bow shock wave. A pseudo-magnetosphere as suggested by Gold and interpreted from Luna 10 measurements is not observed. The interplanetary magnetic field appears to be convected through the lunar body without a large-scale distortion of its direction or magnitude. Perturbations as much as 30% of the average magnitude are noted in the solar plasma umbra and penumbra. As the satellite passes through the leeward flow, an alternating pattern of magnitude increases and decreases is observed in the penumbra, while generally only an increase is observed in the umbra. Using a theoretical model of plasma flow due to Whang, a first-order solution of the perturbed interplanetary magnetic field is compared with observations. It is concluded that the perturbations can be partially explained on the basis of the magnetization, gradient, and curvature currents induced in the disturbed solar plasma flow. The umbral increase and the innermost penumbral decrease are consistent with the first-order theory, and it is suggested that a higher-order approximation is required to explain the newly detected penumbral increases and additional penumbral fluctuations. (auth)

31556 PULSARS AND A POSSIBLE NEW TEST OF GENERAL RELATIVITY. Hoffman, B. (City Univ. of New York). Nature (London), 218: 667-8(May 18, 1968).

It is stated that the discovery of rapidly pulsating radio sources with a remarkably uniform periodicity suggests the possibility of testing a general relativistic effect involving the orbital motion of the Earth and the gravitational field of the Sun. In principle the method would be to look for residual periodic variations, having a period of 1 year, in the apparent N_0 of pulsars, N_0 being apparently greatest at perihelion and least at aphelion, and the difference amounting to about 1 part in 2×10^9. The interpretation would be that the pulsars had stable frequencies and that terrestrial clocks also had stable frequencies, but that the solar curvature of space–time and the centrifugal effect of the Earth's orbital motion give rise to an annually varying red shift that makes terrestrial clocks, when compared with pulsar rhythms by means of light signals, appear to go slower at perihelion than at aphelion. The experiment appears feasible. (UK)

31557 SEARCH FOR OPTICAL VARIABILITY IN SEYFERT GALAXIES. Barnes, T. G. (David Dunlap Observatory, Richmond Hill, Ont.). Astrophys. Lett., 1: 171-2(May 1968).

Observations in the UBV system carried out between April and December 1967, confirm the variability of the Seyfert galaxy NGC 4151 reported by Fitch et al. (1967). The results for NGC 1275 suggest variability, but are not conclusive. No variations are found for NGC 1068, NGC 3077, NGC 3516, and NGC 7469. (auth)

31558 SOLAR SPIN-DOWN AND NEUTRINO FLUXES. Ezer, D. (Middle East Technical Univ., Ankara); Cameron, A. G. W. Astrophys. Lett., 1: 177-9(May 1968).

It is suggested that the failure of Davis to detect a flux of ^{8}B neutrinos from the Sun may result from the maintenance of a high central hydrogen abundance. This could arise from the circulation currents associated with the spin-down of a fast rotating core. On this basis a lower limit to the flux which is about the same as Davis's upper limit is predicted. (auth)

31559 THEORY OF THE SOLAR CORONA. Menzel, D. H. (Harvard Coll. Observatory, Cambridge, Mass. Smithsonian Astrophysical Observatory, Cambridge, Mass.). Astrophys. Lett., 1: 195-6(May 1968).

Solution of the magnetohydrostatic equations for a corona-like envelope surrounding a spherical star, leads to quantitative predictions of temperature, electron density, and variation of electron density with height, which agree closely with those known to exist in the corona. (auth)

31560 PERSISTENT SOLAR MAGNETIC PATTERN EXTENDING OVER EQUATORIAL LATITUDES. Wilcox, John M. (Univ. of California, Berkeley); Howard, Robert. Phys. Rev. Lett., 20: 1252-4(May 27, 1968).

During an interval of one year near the minimum of the 11-yr sunspot cycle, an interpolated pattern of the interplanetary magnetic field was compared with the photospheric magnetic field. This reveals a persistent pattern in the solar field extending over a wide range of heliographic latitude on both sides of the equator. (auth)

31561 MEANS OF MEASURING THE EARTH'S VELOCITY THROUGH THE 3^0 RADIATION FIELD. Condon, J. J.; Harwit, M. (Cornell Univ., Ithaca, N. Y.). Phys. Rev. Lett., 20: 1309-10(June 3, 1968).

The velocity of the Earth's motion with respect to the rest frame of the 3°K cosmic background radiation can be determined by measuring the anisotropy of the radiation. Partridge and Wilkinson attempted to detect this anisotropy at $\lambda = 3.2$ cm; they were able to set an upper limit of 300 km/sec to the component of velocity of the Earth which lies in the plane of the Earth's equator. The purpose of this letter is to show that such measurements can best be made with wideband detectors that are sensitive at millimeter infrared wavelengths where a number of laboratories are about to make rocket observations. (TSS) (auth)

31562 OBSERVATIONAL PROPERTIES OF THE HOMOGENEOUS AND ISOTROPIC EXPANDING UNIVERSE. Gamow, G. (Univ. of Colorado, Boulder). Phys. Rev. Lett., 20: 1310-12 (June 3, 1968).

The purpose of this letter is to establish a common language between theoretical and observational cosmologists. (W.D.M.)

31563 COMMENT ON THE RADIATION SPECTRA FROM QUASARS. Takarada, Katsuo (Kyoto Univ.). Progr. Theor. Phys. (Kyoto), 39: 856-8(Mar. 1968).

It is noted that the flat optical spectra of the quasars, 3C 273B and 3C 286, may be explained by the inverse Compton process in the case of the power spectrum, as opposed to the monoenergetic spectrum, of relativistic electrons. Comparing the results of calculations with observations, physical quantities are estimated for 3C 273B. (W.D.M.)

31564 COSMOLOGICAL CONSEQUENCES OF AN INFINITE DIFFERENCE BETWEEN THE ABSOLUTE VALUES OF THE CHARGES OF THE ELECTRON AND OF THE PROTON. Fischhoff, Etienne (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. A and B, 266: 521-4 (Feb. 19, 1968). (In French).

The hypothesis of the existence of a very slight positive charge disequilibrium in the hydrogen atom, so that the gravitation remains largely dominant, is reviewed. This makes it possible to propose a production mechanism of cosmic rays and of radioelectric waves. A simple model furnishes the orders of magnitude observed. (tr-auth)

31565 THEORETICAL IMPORTANCE OF THE STUDY OF THE PASCHEN DISCONTINUITY IN THE SPECTRA OF STARS. Baylac, Marie-Odile; Pecker, Jean-Claude (Observatoire de Meudon, France. Observatoire de Nice). Compt. Rend., Ser. A and B, 266: 517-20(Feb. 19, 1968). (In French).

The measured Paschen discontinuity seems to be more intense than the theoretical discontinuity: better measurement will permit a better knowledge of the equilibrium of the negative hydrogen ion, in which an opacity maximum almost coincides with the Paschen discontinuity. (tr-auth)

31566 STATISTICAL SPECTRA FOR STELLAR PHOTOSPHERIC CONDITIONS. Allen, C. W. (London Univ.). Mon. Notic. Roy. Astron. Soc., 139: 367-401(1968).

The author's principles of statistical spectroscopy were applied to temperatures ranging from 4000 to 40,000°K and electron densities from 10^{10} to 10^{15} cm^{-3}. A single cosmical composition was adopted and line numbers derived for the first 30 elements and six stages of ionization. The intensities counted covered a range of 24 dex and spectral frequencies ranged from 0 to 1500 kK in 26 steps. The main tabulation gives the number of lines ΣN from all elements per dex of intensity and kK of frequency. Log ΣN is tabulated for eight evenly ranged temperatures and associated electron densities. A correction Δ_e is provided for use with other electron densities. Particular attention was given to lines whose central absorptions are the same as, or less than, the continuum absorption. For such lines the total absorption is always less than that of the continuum, but is close to it at the wavelength of maximum. This wavelength changes with temperature, so that $T\lambda_{max} \approx 0.14$ cm deg in the manner of the Wien law. (auth) (UK)

31567 STELLAR RADIAL VELOCITIES FROM COUDE SPECTROGRAMS. Buscombe, William; Kennedy, Pamela M. (Australian National Univ.,Canberra). Mon. Notic. Roy. Astron. Soc., 139: 341-6(1968).

Radial velocity measures are presented for 40 southern stars of early-type and 30 of late-type, based on high-dispersion spectrograms only. Lists of the lines found to be most reliable for G-type stars of various luminosity classes are included. (auth) (UK)

31568 ANALYSIS OF THE SPECTRUM OF THE LARGE MAGELLANIC CLOUD SUPERGIANT HD 33579. Przybylski, A. (Australian National Univ., Canberra). Mon. Notic. Roy. Astron. Soc., 139: 313-39(1968).

The results of a coarse analysis of HD_{33579} were compared with the results of a similar analysis of the galactic supergiant α Cygni. The abundances of 20 atomic species of 15 elements were determined. It was found that: (1) HD_{33579} is slightly underabundant in metals in comparison with α Cygni, but the difference is only of the order of 0.2 in the logarithm; (2) aluminum is the only exception, and is clearly underabundant by 0.6 in the logarithm; (3) the abundances of HD_{33579} are similar to cosmic abundances of Urey within the accuracy of the curve of growth method. The conclusion can be drawn that the rate of formation of heavy elements is almost the same in our Galaxy and the Large Magellanic Cloud. (auth) (UK)

31569 RADIO SPECTRA OF SOURCES IN THE FOURTH CAMBRIDGE CATALOGUE. III. Williams, P. J. S.; Collins, R. A.; Caswell, J. L.; Holden, D. J. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc., 139: 289-311 (1968).

Using observations at 38, 178, 408, 1410, and 2650 MHz the radio spectra of sources in the declination range 0° to 20° of the 4C catalogue were determined. Over the frequency range 38 to 1410 MHz simple power-law spectra were fitted to each source and as a result it was possible to confirm that over the range of flux densities covered the mean spectral index of sources does not change. It is seen, however, that the mean spectral index of sources selected at any given frequency is a function of that frequency. From observations at 2650 MHz it is clear that the spectra of many sources steepen at frequencies above 1410 MHz, but there is no evidence that this effect is more marked in weaker sources which are assumed to be at greater distances with greater cosmological red shifts; the steepening is more marked in sources of high brightness temperature. Over the whole range of frequencies covered the distributions of spectra among radio galaxies and quasi-stellar sources are very similar. (auth) (UK)

31570 TEMPERATURE OF INTERSTELLAR GRAINS. Krishna Swamy, K. S.; Wickramasinghe, N. C. (Goddard Space Flight Center, Greenbelt, Md.). Mon. Notic. Roy. Astron. Soc., 139: 283-7(1968).

The temperatures of various grain models were computed using the interstellar radiation field in the solar neighbourhood as given by Zimmermann and the best available optical data for graphite and ice. A graphite core of radius 0.05 μ surrounded by an ice mantle of outer radius 0.15 μ (a grain model which fits the extinction law) acquires a temperature of ~20°K. The presence of weakly bound impurity atoms in the crystal lattice can enhance the infrared absorption efficiency at $\lambda \approx 0.1$ cm, and lower the temperatures of all grain models below 10°K. Low grain temperatures favour molecule formation and mantle growth at the grain surfaces. (auth) (UK)

31571 ACCRETION OF SOLID HYDROGEN MANTLES BY GRAINS IN OB ASSOCIATIONS. Wickramsinghe, N. C. (Cambridge Univ., Eng.); Reddish, V. C. Nature (London), 218: 661-2(May 18, 1968).

It is stated that the absence of detectable emission nebulae is a characteristic feature of many clusters and associations. Among such associations is Cygnus OB2, which contains several hundred OB stars and ~100 $M_\odot$ of dust in circumstellar shells, but no H II region. Assuming a normal gas to dust ratio the association should contain ~10^4 $M_\odot$ of interstellar hydrogen, which should give an H II region with emission measure ~10^5 to 10^6. The lack of detectable Hα radiation cannot be attributed to excessive interstellar obscuration, and it seems unlikely that circumstellar shells around newly formed stars contain only dust and no hydrogen. The possibility that these stars are too young for growth of an H II region must be ruled out. It seems that, in spite of a normal hydrogen content, the growth of an H II region has been inhibited in some way. The hydrogen in the protostar cloud before contraction of the central star must have been largely molecular. Gaseous H_2, however, would be very quickly dissociated, in a time scale < ~10 yr, when the central star reaches a temperature ~10^4 °K. The situation may be quite different, however, if the molecular H_2 were able to condense as solid H_2 on graphite grains in the protostar cloud. This possibility is discussed. The situation arises that all the hydrogen in the protostar cloud becomes deposited on grains in a time scale which is shorter than the gravitational collapse time. The initial stages of contraction of the central protostar would therefore proceed in conditions where the cloud was entirely in the form of solid particles, with a high opacity at long wavelengths. If this hypothesis is correct, considerable modifications may become necessary to current theories of star formation. The way in which the protostar cloud breaks up into a central star and a circumstellar shell of comparable mass is also discussed. (UK)

31572 GALACTIC DISCONTINUITY NEAR $l^{II} = 140°$. Brueck, M. T.; Ireland, J. G.; Nandy, K.; Reddish, V. C. (Royal Observatory, Edinburgh). Nature (London), 218: 662-3(May 18, 1968).

It has been suggested that there is a major discontinuity in the stellar and interstellar features of the Galaxy at $l^{II} = 140°$. Evidence comes from large changes in the space densities of Wolf–Rayet stars, dust-embedded OB stars and globules, in the rotation with wavelength of the position angles of interstellar polarisation of starlight, and in the distribution of the position angles of polarisation of the radio emission. These interstellar features appear to rule out the apparent termination of the Perseus Spiral Arm as the cause of the discontinuity. Two alternative possibilities are discussed: either the discontinuity represents the sudden onset of a real deficiency of stars in the anti-centre quadrant, or it is a consequence of high obscuration by a nearby dense interstellar cloud. It is pointed out that there are indications of a change in properties of the interstellar obscuration at about longitude 140°, and observations in this connection are discussed. (UK)

31573 BL LAC IDENTIFIED AS A RADIO SOURCE. Schmitt, J. L. (Univ. of Toronto). Nature (London), 218: 663(May 18, 1968).

It is stated that a new position and optical identification of the radio source VRO 42.22.01, determined with the Algonquin Radio Observatory 150-ft. telescope, places it coincident with the irregular variable star BL Lac. The optical properties of this object, combined with its radio polarisation and unusual microwave spectrum, make it of great interest. (UK)

31574 COSMOLOGICAL SIGNIFICANCE OF TIME REVERSAL. Mullis, K. (Univ. of California, Berkeley). Nature (London), 218: 663-4(May 18, 1968).

It is stated that a recent attempt to explain the apparent overthrow of parity in long-lived kaon experiments (Stannard, Nature 211: 693(1966)) suggested the possibility of an unseen component of the Universe in which matter is of opposite time sense to that in the observable Universe. In this connection a cosmological model with interesting symmetry properties is discussed, and the following picture emerges: (1) matter is being created or transferred to the observable Universe (which at any position is one-half of the total Universe), which maintains a constant density; (2) the Universe appears to be in a state of expansion, and matter, which attains a relative velocity near that of light, is observed to pass through a gravitational singularity, at which time it undergoes a complete CPT reversal; (3) after the reversal the singularity commences the time reversal of gravitational contraction (that is, gravitational expansion) and continues back to the pre-galactic stage; (4) this process continues until at some time, determined by the probability of the transition and coinciding exactly with the rate of matter transferral necessary to maintain a constant density in both time-sense sectors of the Universe, the particles from the singularity revert to their original time sense. The advantages of such a theory are enumerated. The puzzling luminosity–velocity distribution of quasars is also briefly discussed. (UK)

31575 LOW NOISE SOLAR AND LABORATORY SPECTROSCOPY. II. THE REGION AROUND 6708 A IN THE PHOTOSPHERIC SPECTRUM AND THE SOLAR LITHIUM ABUNDANCE. Peach, J. V. (Oxford Univ.). Mon. Notic. Roy. Astron. Soc., 139: 403-14(1968).

The Oxford low noise spectrometer was used to record the Fraunhofer spectrum in the region of the lithium resonance lines with a resolving power of 500,000 and an rms noise level of less than 0.02% of the continuous intensity. As there is no direct evidence of the presence of the lithium lines, the spectra can only be used to set an upper limit to the abundance. Computations of possible wavelength shifts in the lines indicate that they should not be shifted from their laboratory wavelengths by more than the errors of the wavelength scale in the spectra. Using this result it is possible to set an upper limit of 0.61 mÅ to the lithium absorption, which corresponds to an abundance $\log (N_{Li}/N_H) \leq 0.38$ on the scale of $\log (N_H) = 12.00$. This value, although considerably smaller than previously published estimates, is consistent with the observed enhancement of the lines in spot spectra. (auth) (UK)

31576 ON A DASH PROMINENCE. Tifrea, Emilia; Nicolescu, Simona. Stud. Cercet. Astron., 12: 175-6(1967). (In Rumanian).

An example of a dash prominence is presented, where not only the D_3(He), but also the hydrogen lines are dashed. A line-of-sight velocity of 47 km/sec and two values for the kinetic temperature and turbulent velocity (25.656°K; 20.8 km/s from H_β, D_3 and 30.755°K; 18.7 km/s from H_β, H(Ca^+) respectively) are found. According to previous work it is concluded that the state of material in a prominance is not a homogeneous one and that the dashes may be caused by the whirls. (auth)

31577 HIGH CHROMOSPHERIC FLARES WITHOUT CORPUSCULAR GEOPHYSICAL EFFECTS. Popovici, C.; Dinulescu, V.; Dimitriu, A. Stud. Cercet. Astron., 12: 127-35(1967). (In Rumanian).

A criterion is given to determine whether the flare conditions on the Sun or the Sun–Earth transmission conditions are responsible for the non-occurrence of an SSC($F \rightarrow SSC$) after a great flare (class ≥ 2). The production of a flare followed by an SSC prior to a second flare (in a time interval ≤ 3 days), in the same solar activity center, is a positive indication of the favorable Sun–Earth transmission conditions for the second flare. A list of such double events ($SSC \rightarrow F, \Delta t, F' \nrightarrow SSC'$) is given to permit the study of the particularities of the flares which do not produce corpuscular emissions. Considering the number of cases ($F \rightarrow SSC, \Delta t, F' \rightarrow SSC'$), ($F \rightarrow SSC, \Delta t, F' \nrightarrow SSC'$), ($F \nrightarrow SSC, \Delta t, F' \rightarrow SSC'$), ($F \nrightarrow SSC, \Delta t, F' \nrightarrow SSC'$) it is found that the probabilities of emission $p_e = 0.69$ and transmission $p_t = 0.81$ of a SSC corpuscular cloud, from a flare, in a simplified model. The counts of single events $F \nrightarrow SSC$ give $p_e p_t = 0.64$ in good agreement with the value $p_e p_t = 0.57$ deduced from the double events. Statistics of the flares, $F \nrightarrow SSC$, shows a preponderence of such flares in the northern hemisphere, and particularly in the northeast quadrant. (auth)

31578 SPATIAL DISTRIBUTION OF QUASARS. Dzervitis, U. K. (Astrophysical Lab., Riga). Latv. PSR Zinat. Akad. Vestis, No. 11, 101-4(1967). (In Russian).

Data about positions of 187 quasars were used to investigate their spatial distribution. The distribution showed that quasars were extragalactic objects. Parameters were estimated according to cosecant law. It was found that quasars did not show the tendency to cluster around nearest galaxies and clusters of galaxies and, on the basis of spatial distribution, the conclusion was drawn that it was more likely for quasars to be at cosmological distances. (auth)

31579 ABSOLUTE MEASUREMENT OF THE ENERGY EMITTED BY THE CENTER OF THE SOLAR DISK AT 4477 TO 8638 A. Peyturaux, R. (Institut d'Astrophysique, Paris). Ann. Astrophys., 31: 227-35(Mar.-Apr. 1968). (In French).

The energy emitted by the center of the solar disk was measured at Mont-Louis (altitude 1,600 m) between 1960 and 1965 in the wave length range 4477 to 8638 Å. The solar radiation was compared to a black body kept in vacuum at 2600°K. The light beams from the Sun and the black body were received on the slit of a prism monochromator via the same optical system which incorporated a polar siderostat. The only element of the system which was not common to both beams was a collimating mirror which formed an image of the black body at infinity. The atmosphere attenuation was measured with a specially designed instrument which continuously recorded the wavelength of the radiation which was being measured over a solar diameter. A photomultiplier or a photoconductive cell (Pbs) were employed as detectors, depending upon the spectral region. The balance was obtained by means of daily calibrated optical attenuation and by adding electric attenuations which never exceeded a factor of 50. Instrumental effects were taken into account: polarization partly experimental, partly theoretical, dispersion by computation, absorption through experiments. The internal accuracy seems to be about 3%. The results are in agreement with Sitnik's but differ by as much as 20% from Labs and Neckel's. This discrepancy is not clearly understood, so that a new series of measurements is being planned. (auth)

31580 ASYMPTOTIC EXPRESSION FOR NONRADIAL MODES OF MASSIVE STARS. Smeyers, P. (Univ., Louvain, Belgium). Ann. Astrophys., 31: 159-65(Mar.-Apr. 1968). (In French).

Asymptotic expressions are given for the stable and unstable types of gravitational modes, which occur in models of massive stars composed of a convective core and a radiative envelope. (auth)

31581 DETERMINATION OF MASSES OF PLANETARY NEBULAE BY THEIR RADIO FLUX. Vauclair, Gerard (Institut d'Astrophysique, Paris). Ann. Astrophys., 31: 199-204(Mar.-Apr. 1968). (In French).

The radii, distances, and masses of planetary nebulae were computed using densities and temperatures derived from [O II] and [O III] lines and radio flux data in the optically thin part of their spectrum. Assuming the mass obtained in this way to the total mass of the nebula results were found ranging from 3×10^{-2} $M_\odot$ to 2 or 3 $M_\odot$. The spread of these values is discussed. (auth)

31582 EARLY HEAT GENERATION IN METEORITES. Reeves, H.; Audouze, J. (CEN, Saclay, France. Institut d'Astrophysique, Paris). Earth Planet. Sci. Lett., 4: 135-41 (Apr. 1968).

The amount of radioactive material generated by an early solar-proton irradiation of the surrounding gases is considered. The total flux is monitored by the meteoritic abundance of ^{9}Be. The heat released this way (mostly by ^{26}Al) is found to exceed largely the heat coming from "galactogenic" sources (mostly ^{40}K and possibly also ^{129}I) and may have influenced considerably the very early heat history of the meteorites. (auth)

31583 FORMATION OF POLYATOMIC MOLECULES AND C_2 ABUNDANCE IN THE SUN. Raghavan, Nirupama (Indian Inst. of Tech., Kanpur). Ann. Astrophys., 31: 245-6(Mar.-Apr. 1968).

In the light of new molecular data available for dissociation processes a more complete consideration of the equilibrium distribution of C_2 in the solar atmosphere is attempted. The following are considered: H_2, H_2O, H^+, H^-, CH, CH_2, C_2H_2, C_2H, NH, OH, C_3, C_2, CN, CO, N_2, NO, and O_2. (W.D.M.)

31584 OBSERVATIONS OF SMALL GALAXIES WITH THE 21-CM LINE OF HYDROGEN. Bottinelli, L.; Gouguenheim, L.; Heidmann, J.; Heidmann, N. (Observatoire de Paris, Meudon, France). Ann. Astrophys., 205-25(Mar.-Apr. 1968). (In French).

The Nançay radiotelescope was used to make 21-cm observations of small galaxies. Out of 55 galaxies observed, 30 were measured, 21 of which were new measurements. The center of each galaxy and, for 15 of them, adjacent points were observed. This gives a mean H I distribution, extending much farther than the optical emission for spirals. The systemic velocities obtained are compared with the optical values and, over a range of 2,000 km/sec, show no systematic deviation. A new determination was made of the distances of the 150 galaxies of the program, using published results on Cepheids, H II region diameters, luminosity classes, mean optical emissivity, and groups. The hydrogen masses M_H were obtained and plotted as a function of type, showing a decrease of the maximum value by a factor of 10 as one goes from Sb to Ir. The width of the 21-cm-line profiles was used to get estimates of the total masses. The use of two extreme models and the discussion of optical data show that the total mass is given within a factor of 3 by what is called the indicative mass M_i. This is plotted as a function of type and shows a very large decrease as one goes from Sb to Ir. The hydrogen and indicative masses were compared to the intrinsic luminosities L_* and their ratios were plotted in a triangular diagram. It is shown that, from Ir to Sb, M_H/L_* decreases moderately, M_H/M_i decreases strongly, and M_i/L_* increases slightly. (auth)

31585 PROPAGATION OF SHOCKS IN STELLAR ENVELOPES OF BRINKLEY–KIRKWOOD THEORY. Sachdev, P. L. (Indian Inst. of Science, Bangalore). Ann. Astrophys., 31: 173-8(Mar.-Apr. 1968).

The propagation of a shock wave through stellar envelopes was considered. The models chosen for the purpose were those of a hot star and a giant star. The well-known Brinkley–Kirkwood theory was extended to take account of the self-gravitation of the gas and the loss of radiation from the shock. The later was accomplished by following Weymann's assumption regarding the path of the particle after it has crossed the shock. A number of cases was considered with different initial shock strengths and different initial energy of the shock. The time that a shock of a certain initial strength and initial energy takes to arrive at the surface of the star and the amount of stellar mass that might escape from the star through the mechanism of sufficiently strong shocks were estimated. The mode of dissipation of shock energy in the stellar models, which is an important feature of the Brinkley–Kirkwood theory was estimated. (auth)

31586 TECHNETIUM IN RED GIANTS. III. POSSIBLE SYNTHESIS OF ^{97}Tc. Arnould, Marcel (Univ., Brussels). Ann. Astrophys., 31: 179-97(Mar.-Apr. 1968). (In French).

It is shown that positon capture, β^- disintegration, and photobeta processes can transform a significant quantity of ^{97}Mo into ^{97}Tc in a nondegenerate very hot stellar medium, ^{97}Mo having been synthetized previously through a chain of neutron captures. ^{97}Tc seems to be both synthetized and observed: with the highest probability during the carbon-burning phase or slightly later (if neutrino losses can be neglected) in stars massive enough not to be degenerate and light enough not to evolve too fast, especially if neutrino luminosity is not negligible. In those conditions, ^{97}Tc can be produced in equilibrium with ^{97}Mo. However, one is not able to conclude that ^{97}Tc is more likely to be observed than ^{99}Tc: the mass of stars showing Tc lines is not known with enough accuracy and the abundance ratio n(^{97}Tc)/n(^{99}Tc) is probably increasing with stellar mass. On the other hand one does not know exactly the extent of the convective zones in red giants at a late stage of their evolution. (auth)

31587 THERMAL STABILITY OF PURE CARBON STARS. Gabriel, M.; Noels-Groetsch, A. (Univ., Liege). Ann. Astrophys., 31: 167-72(Mar.-Apr. 1968). (In French).

The thermal stability of pure carbon stars was studied. The results are very similar whether or not the neutrino losses are taken into account. If β_c (M_{min}) is the central value of the ratio of the gas pressure to the total pressure for the model of minimum mass, models for which $\beta_c < \beta_c$ (M_{min}) (weak degeneracy) are stable while those with $\beta_c > \beta_c$ (M_{min}) are unstable. This result can be interpreted in terms of an extension of Poincaré's linear series. (auth)

31588 PRESENT STATUS OF THE THEORETICAL PREDICTIONS FOR THE ^{37}Cl SOLAR-NEUTRINO EXPERIMENT. Bahcall, John N. (California Inst. of Tech., Pasadena); Bahcall, Neta A.; Shaviv, Giora. Phys. Rev. Lett., 20: 1209-12(May 20, 1968).

The theoretical predictions for the ^{37}Cl solar-neutrino experiment are summarized and compared with the experimental results of Davis, Harmer, and Hoffman. Three important conclusions about the Sun are shown to follow. (auth)

31589 COLLECTION OF SPECTRAL DIAGRAMS OF SOLAR RADIO TYPE IV EVENTS. Fokker, A. D.; Goh, T.; Landre, E.;

Roosen, J. (Rijksuniversiteit, Utrecht). Bull. Astron. Inst. Netherlands, Suppl. Ser., 1: 309-24(Oct. 1966).

A collection of spectral diagrams of solar radio type-IV events were studied. The diagrams are based on a number of single-frequency records contributed by several observatories. Certain characteristics are found that are common to a number of different events. A sudden beginning is noted that is simultaneous over almost the whole range of radio frequencies. This is common to the majority of the events. Other features are: some precursory activity, followed by a main phase; a second hump, predominantly in the centimetric and decimetric frequency range; a succession of isolated peaks and "islands," predominantly in the decimeter band; continued emission at metric and/or decametric frequencies; and a more or less clear-cut separation between the parts of the spectrum at higher and at lower frequencies. Examples of these features are given. (IAA)

31590 SEARCH FOR NEUTRINOS FROM THE SUN. Davis, Raymond Jr.; Harmer, Don S.; Hoffman, Kenneth C. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Lett., 20: 1205-9 (May 20, 1968).

A search was made for solar neutrinos with a detector based upon the reaction $^{37}Cl(\nu,e^-)^{37}Ar$. The upper limit of the product of the neutrino flux and the cross sections for all sources of neutrinos was 3×10^{-36} sec^{-1} per ^{37}Cl atom. It was concluded specifically that the flux of neutrinos from ^8B decay in the Sun was equal to or less than 2×10^6 cm^{-2} sec^{-1} at the Earth, and that less than 9% of the Sun's energy is produced by the carbon–nitrogen cycle. (auth)

31591 SOME PROBLEMS IN COSMIC GAS DYNAMICS. Newman, Robert Chapman. Ithaca, N. Y., Cornell Univ., 1967. 153p. Thesis.

A steady-state, spherically symmetric, nonviscous, polytropic model of a stellar wind is examined and it is shown that the addition of a shock at the proper distance from the central star allows the solution to fit an arbitrary pressure in the interstellar medium, although for sufficiently large values of this pressure the flow is completely subsonic so that no shock occurs. The more complex equations involving viscosity and heat conduction are solved by a singular perturbation in the transonic region to show that shocks actually do occur and that they become thinner and stronger the farther they are from this region. The effect of a cosmic-ray pressure gradient in choking off the solar wind is considered, but it appears that this is not very important. The spherically-symmetric expansion of an H II region around a hot central star is treated using a constant-velocity similarity solution in the ionized and neutral regions, taking the ambient density to be initially constant. The solutions are made unique (i.e., a given radiation flux implying a given ionization front speed) for a star with effective temperature 40,000°K by examining the ionization front structures, allowing for cooling in the H II region by O^+ ions and taking the H I region to behave either adiabatically or isothermally. The general appearance of these models fits the observations except that the shocked neutral region ahead of D-type fronts appears to be too thin. Next, the stability of plane strong D- and weak R-type ionization fronts is examined assuming isothermal H I and H II regions and allowing for the absorption of photons in the H II region. It is found that the former are stable and the latter are weakly unstable unless photon absorption is neglected. The effect of ion recombination in a stellar wind flow is treated for the spherically-symmetric ejection of ionized gas from a hot central star into a medium with finite pressure. The H II region is assumed to be isothermal and the H I region to behave adiabatically, and the structure of recombination fronts is examined to match solutions in the two regions. A set of solutions for a 40,000° star and a gas flow with a Mach number of 10 just inside the unshocked H II region is given for various values of the ambient gas density. The model may be significant for some stellar winds and nonexpanding planetary nebulae. Finally, the energy balance of the interstellar medium is considered, with emphasis on the production and destruction of molecular hydrogen by grain exchange reactions and H II regions, respectively. Contrary to some recent work by other authors, the proportion of hydrogen atoms in molecular form to those in atomic form seems to be quite small, only 1 to 10%. (Diss. Abstr.)

31592 RADAR ASTRONOMY. Evans, John V.; Hagfors, Tor (eds.). New York, McGraw-Hill Book Co., 1968. 639p. $19.50.

The book specifically deals with the propagation of radio waves through media such as planetary atmospheres and the interplanetary medium; the detection of weak signals in noise; and the design and analysis of radar experiments intended to yield information on lunar and planetary surface conditions or on interplanetary distances and orbital motions. A detailed account is given of the design of the high-power radar systems needed and of the primarily digital data analysis methods which must be employed. Extensive and up-to-date accounts are given of radar studies of the Sun, Moon, and near planets. (W.D.M.)

Atomic and Molecular Physics

Refer also to abstracts 31795, 32611, 30593, 31553, and 31566.

31593 (CALT-532-17) REACTION OF MONOENERGETIC DEUTERIUM ATOMS WITH HYDROGEN MOLECULES. Kuppermann, Aron (California Inst. of Tech., Pasadena. Gates and Crellin Labs. of Chemistry). [1967]. Contract AT(04-3)-532. 17p. (CONF-670838-1). Dep. CFSTI.

From 4th Nobel Symposium, Stockholm, Sweden.

The following topics are discussed: reaction cross sections and rate constants, experimental methods for determining reaction cross sections, and theoretical analysis of monochromatic atom reactions. The concept of the reaction cross section is developed from considerations of the rate of reaction in constant energy interaction of molecular pairs. The interaction is assumed to be adiabatic so that the Born–Oppenheimer approximation is applicable. The time-independent Maxwell–Boltzmann distribution function is used to relate the bimolecular thermal rate constant K(T) to the time-independent rotationally averaged reaction cross section $\sigma(E)$. Previous methods are indicated for determining $\sigma(E)$ from K(T) for the reaction $D + H_2 \rightarrow DH + H$. The reaction of ground-state D atoms with a thermal H_2 gas at temperatures less than 1000°K is studied. A method is introduced whereby $\sigma(E)$ can be measured from the $[DH]/[D_2]$ ratio resulting from photolyzing DI in an excess of H_2 with monochromatic light of variable wavelength. It was possible to generate monoenergetic D atoms of known and controllable energies which undergo reactive or nonreactive collisions with H_2. The ratio of the effective rate constant k_1 for the hot reaction to the sum of it plus k_2 for thermalization is determined for the measured $[HD]/[D_2]$. This ratio is the phenomenological threshold energy. A theoretical derivation is given to relate $k_1/k_1 + k_2$ to $\sigma(E)$, assuming a steady-state photolysis condition in the laboratory energy range. It is shown that the effects of thermal motion of the H_2 and of the deactivating collisions are to broaden the distribution function, though the important region of the $\sigma(E)$ curve may be sampled well. (TSS)

31594 (COO-1112-159) A MEASUREMENT OF THE SPIN-EXCHANGE CROSS SECTION OF ^{133}Cs, ^{87}Rb, ^{85}Rb, ^{39}K AND ^{23}Na. Ressler, Neil W. (Michigan Univ., Ann Arbor. Dept. of Physics). Sept. 1967. Contract AT(11-1)-1112. 111p. Dep. CFSTI.

Electron paramagnetic resonance was used to measure the spin-exchange cross sections for $^{133}Cs-^{133}Cs$, $^{87}Rb-^{87}Rb$, $^{85}Rb-^{85}Rb$, $^{39}K-^{39}K$, and $^{23}Na-^{23}Na$ collisions. Density measurements were made by comparing the magnetic resonance signal of the alkali with that of a calibrated standard. The cross sections obtained are as follows: ^{133}Cs, $2.06^{+0.20}_{-0.35} \times 10^{-14}$ cm^2; ^{87}Rb, $1.85^{+0.20}_{-0.30} \times 10^{-14}$ cm^2; ^{85}Rb, $1.92^{+0.20}_{-0.30} \times 10^{-14}$ cm^2; ^{39}K, $1.45^{+0.15}_{-0.25} \times 10^{-14}$ cm^2; ^{23}Na, $1.03^{+0.10}_{-0.20} \times 10^{-14}$ cm^2. (auth)

31595 (FOA-4-4346-23) COMPRESSED ATOMS. II. APPLICATION TO Al AND Fe. Berggren, K-F; Froman, A. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). Mar. 1968. 36p. Dep.

The spherical cellular model, which treats an atom confined to a finite spherical volume, was used to make a quantum-mechanical study of some properties of Al and Fe at various compressions. The calculations were performed with a Thomas–Fermi potential and an approximate self-consistent potential in the Hartree–Fock–Slater equations. The pressure–density relation at 0°K and some electronic properties, e.g., band structure and specific heat were calculated and compared with results of experiments and of other theories. It is shown that spherical cellular model in its present version does not give reliable quantitative results, but qualitatively, it gives an improvement on the statistical models. (auth) (Sweden)

31596 (NP-tr-1637) EXISTENCE AND PROPERTIES OF TRIATOMIC DEUTERIUM MOLECULAR JETS. Devienne, F. Marcel. Translated for Culham Lab., Abingdon, Eng., from Compt. Rend., Ser. A and B, 264: 1400-3(May 17, 1967). 6p. (CTO-454). Dep. CFSTI. UK. JCL $1.10 fs, $0.80 mf.

An abstract from the original French article appeared in NSA 21: 41777. (M.H.R.)

31597 (ORNL-4238, pp 105-15) ATOMIC AND MOLECULAR CROSS SECTIONS. Barnett, C. F.; Krause, M. O.; Ray, J. A.; Sellin, I. A.; Langley, R. A. (Oak Ridge National Lab., Tenn.).

Further progress on each of the following is described: (1) Rydberg state autoionization of H_2, D_2, and HD, (2) charge exchange of hydrogen particles in magnesium, (3) energy-dispersed beams, (4) crossed-beam experiment, (5) measurement of subshell contributions to the total photoabsorption cross section of Kr and Xe at 300 to 2500 eV, and (6) multiplier evaluation. (M.O.W.)

31598 (ORNL-4238, pp 116-20) HIGH-CURRENT ION BEAM PRODUCTION AND INJECTION. Davis, R. C.; Hall, R. R.; Kelley, G. G.; Morgan, O. B.; Stratton, R. F. (Oak Ridge National Lab., Tenn.).

The major effort during this report period has been on continuation of the ion-optical studies described in the last report. It was found that the limitation of beam quality is due entirely to the shape of the ion emission surface and the extraction field, at least in the situations examined. With large extracted currents the plasma surface has a complicated shape and strong curvature as a result of nonuniformity of plasma density in the ion source cup. Efforts to control this surface using conventional sources have not produced significantly better results. (auth)

31599 (ORO-3027-13) THE EXCITATION AND IONIZATION OF IONS BY ELECTRON IMPACT. [Progress Report], June 1, 1967–April 30, 1968. Hooper, J. W. (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). May 1, 1968. Contract AT(40-1)-3027. 10p. Dep. CFSTI.

The essential features of the apparatus and techniques being used in the following are summarized briefly: (1) measurements of cross sections for excitation and ionization of Ba^+ ions by electron impact, and (2) study of energy loss by protons and singly charged Li ions upon passage through thin films. (A.G.W.)

31600 THE INTERACTION OF MULTI GeV IONS AS HEAVY AS URANIUM WITH MATTER. Wallace, R.; Litton, G.; Steward, P. (Univ. of California, Berkeley). Trans. Amer. Nucl. Soc., 11: 400-1(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31601 SOFTENING OF RADIATION BY MULTIPLE COMPTON SCATTERING. Pomraning, G. C. (Gulf General Atomic Inc., San Diego, Calif.). J. Quant. Spectrosc. Radiative Transfer, 8: 1087-1100(Apr. 1968).

A simplified equation of transfer is applied to the problem of computing the spectral change in radiation due to multiple Compton collisions with stationary free electrons. Two model problems are considered, both of which show the softening of radiation, but somewhat differently. The first solution, corresponding to a time-dependent, space-independent problem, shows that an initial monochromatic distribution propagates downward in frequency, but retains its monochromatic character, i.e., no dispersion is observed. The second solution corresponds to the steady-state problem of transmission through an atmosphere of finite thickness. This solution shows that a monochromatic distribution incident on the atmosphere undergoes significant broadening, but toward the red side only. This is in contrast to previously published solutions to this same problem, which show the physically incorrect behavior of some broadening toward the violet as well. (auth) (UK)

31602 HARTREE-FOCK INTEGRO-DIFFERENTIAL EQUATIONS FOR ATOMS. Sharma, C. S. (London Univ.). Proc. Roy. Soc. (London), Ser. A, 304: 513-30(May 7, 1968).

Hartree–Fock integro-differential equations have been classified to avoid confusion arising from the use of the same name for approximations of different natures. The proper orthonormality conditions for the perturbation expansions of these equations have been established. For the totally unrestricted Hartree–Fock equations for the ground state of helium-like ions it is shown that, corresponding to the expansion of the one-electron functions u and v as power series in $1/Z$, $u \equiv v$ is the only solution. The status of the perturbation expansion of these one-electron functions as power series in $1/Z^{1/2}$ was considered in some detail and it is shown that the half-order functions satisfy well-defined nonlinear integro-differential equations. Various misunderstandings in the literature are corrected. (auth) (UK)

31603 EXCHANGE EFFECTS IN THE ROTATIONAL EXCITATION OF MOLECULAR HYDROGEN BY SLOW ELECTRONS. Ardill, R. W. B.; Davison, W. D. (Queen's Univ., Belfast). Proc. Roy. Soc. (London), Ser. A, 304: 465-77(May 7, 1968).

The scattering formalism of Arthurs and Dalgarno (1960) is generalized to take account of exchange (but not polarization) in the scattering of slow electrons by molecular hydrogen. The use of a single-centre molecular wavefunction is discussed, and representative calculations of the $j = 0 \rightarrow j = 2$ rotational excitation cross section are carried out in the distorted wave approximation. The inclusion of exchange results in a significant increase (rising from 12% at 0.1 eV to over 70% at 0.5 eV) in the dominant (p-wave) contribution to the cross section. It is concluded that exchange effects cannot be ignored in the theoretical discussion of electron energy loss by rotational excitation in swarm experiments. (auth) (UK)

31604 COMPUTATION OF ELECTROSTATIC INTERACTION INTEGRALS CONNECTED WITH PAIR COUPLING IN SOME LIGHT ATOMS. Eriksson, K. B. S. (Univ. of Lund, Sweden). Ark. Fys., 35: 225-8(1968).

Electrostatic interaction integrals were calculated from screened hydrogenic orbitals. These values of $F_2(2p,4f)$ and $F_2(2p,5g)$ are about 5% smaller than those observed in C I, N I, N II, and O II. The observed values are described by means of empirical relations in terms of the effective nuclear charges: $F_2(2p,4f) = 34.5\ Z_{2p}^{-2}\ Z_{4f}^{3}$, and $F_2(2p,5g) = 1.577\ Z_{2p}^{-2}\ Z_{5g}^{3}$. (auth) (Sweden)

31605 CHARACTERISTIC ENERGY LOSS SPECTRA OF COPPER CRYSTALS WITH SURFACES DESCRIBED BY LEED. Jordan, L. K.; Scheibner, E. J. (Georgia Inst. of Tech., Atlanta). Surface Sci., 10: 373-91(June 1968).

Energy distributions of electrons backscattered from copper (100) and (110) surfaces have been obtained for incident electron energies in the range 30 to 350 eV. The relations between optical measurements and the characteristic energy losses, as well as the effect of interband transitions on the bulk and surface plasmon frequencies in metals which do not have ideally free electron plasmas are discussed. By chemisorbing increasing amounts of oxygen on the clean surface, the surface plasmon loss peak was identified in the copper energy loss spectrum from its intensity dependence on the dielectric constant at the surface. This peak has been identified by previous authors as the bulk plasmon loss of a single s-electron plasma oscillation. Our identification of the surface plasmon loss peak implies that the d electrons in copper do participate in the plasma oscillation and that the bulk plasmon frequency is shifted from its free electron value because of interband transitions. (auth)

31606 RELATIVE SPUTTERING YIELDS FROM CLOSE-PACKED DIRECTIONS IN NICKEL UNDER LOW-ENERGY Ar^+ BOMBARDMENT. Cuderman, J. F.; Brady, James J. (Oregon State Univ., Corvallis). Surface Sci., 10: 410-28(June 1968).

A new approach to low-energy sputtering was developed wherein a monoenergetic Ar^+ ion beam of the order of 10^{-9} A impinged onto a crystalline nickel target. Target preparation consisted of plating about 100 monolayers of high-specific-activity Ni-63 onto a cold-rolled nickel substrate and then heating the target above its recrystallization temperature under ultrahigh vacuum. The result was a highly ordered polycrystalline structure which, when sputtered, behaved like the (100) surface of a nickel single crystal. Approximately 25% of the surface atoms were Ni-63. Sputtered material was collected on a molybdenum foil which was subsequently analyzed by radiotracer techniques. Experimental results concerning sputtering from [110] and [100] close-packed directions in nickel under bombardment by Ar^+ ions of energy 25 to 600 eV are reported. The relative sputtering yields from [110] directions are presented as a function of incident ion energy for 75 and 15° ion incidence measured with respect to the [110] directions, and the extrapolated thresholds are compared with theoretical predictions. In addition to the expected deposits on the foil due to sputtering from individual close-packed directions, secondary deposits occurred which are attributed to specular reflection of sputtered nickel atoms from the molybdenum foil. (auth)

31607 POSITRON ANNIHILATION. Frait, Zdenek; Fraitova, Dagmar (Fysikalni Ustav, Prague). Cesk. Cas. Fys., 18: 315-31(1968). (In Czech).

A brief review of Fermi surface studies of metals by the method of positron annihilation is given in the paper. The principles of measurements of the angular distribution of annihilation photons and the experimental apparatus are described. The basic theory of the electron–positron annihilation in one-particle representation and some results of many-body solution are discussed. Finally, as an example of the method, the annihilation measurements and Fermi surface determination on lithium are described. (auth)

31608 ELECTRON CAPTURE INTO THE METASTABLE 2s STATE IN COLLISIONS OF PROTONS WITH HYDROGEN ATOMS. Bayfield, James E. (Yale Univ., New Haven). Phys. Rev. Lett., 20: 1223-6(May 27, 1968).

The cross section $\sigma_{2s}(H)$ for the atomic collision reaction $H^+ + H(1s) \rightarrow H(2s) + H^+$ has been measured for proton energies between 3 and 23 keV. The data provide a relatively sensitive test of available cross-section calculations. Good agreement exists with a three-state atomic-eigenfunction expansion calculation that includes as an intermediate state only the 2s state about the target proton. The Born approximation fails to predict the measured energy dependence below 20 keV. (auth)

31609 ENERGY DEPOSITION BY ELECTRON BEAMS AND δ RAYS. Kobetich, E. J.; Katz, Robert (Univ. of Nebraska, Lincoln). Phys. Rev., 170: 391-6(June 10, 1968).

The product of two empirical relations, for the practical range and the transmission probability of normally incident electrons through plane sheets of matter, may be differentiated to yield a simple formulation of the energy deposition by electron beams, in agreement with more complex formulations and with experimental data. When combined with the δ-ray distribution formula, these results provide a theory of the spatial distribution of ionization energy about the path of a rapidly moving ion, which is basic to theories of radiation damage and detection. (auth)

31610 EVIDENCE OF THE EXISTENCE OF AN He_3^+ ION. Patterson, P. L. (Joint Inst. for Lab. Astrophysics, Boulder, Colo.). J. Chem. Phys., 48: 3625-31(Apr. 15, 1968).

An ion-mobility apparatus was used to study the chemistry of helium ions in helium at gas pressures of 1 to 30 torr and temperatures of 300 to 76°K. At temperatures below 200°K, the He_2^+ ion was observed to convert to an ion believed to be He_3^+. Identification of the He_3^+ was based upon observations of its behavior under varied experimental conditions. At 76°K, the rate of formation of He_3^+ from He_2^+ was faster than the three-body formation of He_2^+ from He^+. The rate coefficient of the latter reaction was found to be $1.7 \pm 0.4 \times 10^{-31}$ cm^6/sec at 76°K. Between the temperatures of 135 and 200°K, He_2^+ and He_3^+ were present in equilibrium. A He_3^+ dissociation energy of 0.17 ± 0.03 eV was determined from measurements of the equilibrium constant as a function of temperature. (auth)

31611 MEASUREMENT OF POSITRON ANNIHILATION LINE SHAPES WITH A Ge(Li) DETECTOR. Hotz, H. P.; Mathiesen, J. M.; Hurley, J. P. (Naval Radiological Defense Lab., San Francisco). Phys. Rev., 170: 351-5(June 10, 1968).

It was observed that the annihilation radiation photopeak in a Ge(Li) detector is considerably broader than that of a γ ray of the same energy. It seems reasonable to assume that the increased width is the result of the Doppler broadening of the annihilation photopeak, i.e., the longitudinal Doppler shift of the radiations is measured, while the transverse shift is measured in the usual angular-correlation experiments. By using the detector, momentum distributions in agreement with those published were obtained. Only one detector is necessary for these measurements, and all momentum channels are detected at once. However, the detector energy resolution severely limits the momentum resolution. Arguments are presented, which indicate that no very large improvement in Ge(Li) detector resolution can be expected. (auth)

31612 MODEL ATOMIC HAMILTONIANS. Piech, Kenneth R.; Wilson, Kenneth G. (Cornell Univ., Ithaca, N. Y.). J. Chem. Phys., 48: 3740-50(Apr. 15, 1968).

A model Hamiltonian for the n = 1 and n = 2 states of the first- and second-row atoms is developed. The model is easily soluble and represents total and ionization energies reasonably well. The model is constructed on a cubic lattice space and is defined by five postulates. They are: (1) each electron is confined to seven lattice sites: the origin and its six nearest-neighbor sites; (2) the form of the Hamiltonian is taken from the finite difference approximation to the exact Hamiltonian; (3) the parameters in the Hamiltonian are determined phenomenologically; and (4) the parameters scale as simple functions of Z. The fifth postulate allows one to distinguish s states from p states in the spectra of the models. A matrix diagonalization problem results which is easily solved by perturbation expansion. The model is applied to the atoms H to B, together with associated isoelectronic sequences. Ionization energies are given to approximately 25%, and total energies to approximately 2%. The eigenfunctions of the model are of nonproduct form and demonstrate correlation effects. A simple approximation to the ground-state energies of H–Ne is developed, which involves a calculation of the minimum-energy electron configuration on the seven-point lattice, and which is accurate to approximately 3%. The model results are compared to previous semiempirical Z^{-1} expansions of ground-state atomic energies. Implications of the model for the problem of complex molecules are discussed. (auth)

31613 PHOTOIONIZATION CROSS SECTIONS FOR N AND O^+. Henry, Ronald J. W. (Kitt Peak National Observatory, Tucson, Ariz.). J. Chem. Phys., 48: 3635-8(Apr. 15, 1968).

Photoionization cross sections for atomic nitrogen are presented for wavelengths longer than 150 Å. Multichannel expressions, in the dipole approximation, are used to calculate cross sections for ejection of an outer subshell electron. The effect of coupling between final state channels is to bring the dipole velocity and length forms of the cross sections into slightly better agreement with each other. Single channel expressions, in the dipole approximation, are used to calculate cross sections for the ejection of an inner subshell electron. Cross sections, calculated in the dipole velocity approximation, are in good agreement with experimental results of Comes and Elzer, except for wavelengths where autoionization occurs. Photoionization cross sections for singly ionized oxygen are presented for wavelengths longer than 100 Å. (auth)

31614 PRESSURE OF IDEAL QUANTUM GASES. Falk, Harold (City Univ. of New York). Amer. J. Phys., 36: 454 (May 1968).

A simple theorem is given which is not restricted to a particular energy spectrum and which does not involve the replacement of sums by integrals and which may contribute pedagogically to the problem of finding the equation of state. (W.D.M.)

31615 ANOMALOUS ION–MOLECULE REACTION RATES IN DRIFT TUBES. Whealton, John H.; Woo, Shien-biau (Univ. of Delaware, Newark). Phys. Rev. Lett., 20: 1137-41(May 20, 1968).

The effects of three-dimensional drift and diffusion phenomena in mobility-tube measurement of rates of ion–molecule reactions in the gaseous phase were investigated theoretically. It was found that, in some cases, failure to account for the lateral diffusion loss of ions may lead to apparent rates in error by as much as a few orders of magnitude. Experimental methods for minimizing lateral diffusion loss are suggested briefly. (A.G.W.)

31616 ELECTRON FLUX SPECTRA IN ALUMINUM: ANALYSIS FOR LET SPECTRA AND EXCITATION AND IONIZATION YIELDS. McConnell, W. J.; Birkhoff, R. D.; Hamm, R. N.; Ritchie, R. H. (Oak Ridge National Lab., Tenn.). Radiat. Res., 33: 216-28(1968).

Measurements were made on the electron flux generated in effectively infinite aluminum media by uniformly distributed sources of ^{198}Au and ^{64}Cu. Above 100 keV, the shapes of the flux spectra were determined by the integral primary beta spectrum. Between 100 keV and 5 keV, the flux was constant. Between 5 keV and 100 eV, the flux rose as 1/E, and below 100 eV it rose as about $1/E^3$. On an absolute basis, the experiment was in agreement with the Spencer–Fano theory above 10 keV but exceeded the theory by as much as a factor of 4 at 400 eV. The results were analyzed to obtain LET spectra as well as K-shell and L-shell ionization, volume plasmon excitation, and electron-electron interaction yields. The conclusions drawn from the analysis were that electrons with energies less than 55 eV contribute as much to the flux in LET space as do electrons with energies greater than 55 eV, that electrons are nearly mono-LET particles, and that volume plasmon excitation accounts for nearly all the energy delivered to an aluminum medium by an electron slowing down in it. (auth)

31617 POSITIVE-ION MOBILITIES IN DRY AIR. Sinnott, G.; Golden, D. E.; Varney, R. N. (Lockheed Research Lab., Palo Alto, Calif.). Phys. Rev., 170: 272-5(June 5, 1968).

Drift velocities of mass-identified positive ions in air have been measured to about ±5% as a function of E/N for $2 \times 10^{-16} \lesssim E/N \lesssim 2 \times 10^{-14}$ V cm^2 and for $1.8 \times 10^{15} \lesssim N \lesssim 7 \times 10^{16}$ cm^{-3}. These measurements lead to values of the zero-field mobilities of 1.6, 3.5, and 2.5 cm^2/V sec for N_2^+, NO^+, and O_2^+, respectively, in air. The high-E/N data yield momentum-transfer cross sections of 110, 21, and 30 $Å^2$ for N_2^+, NO^+, and O_2^+, respectively. The rapid disappearance of N^+ and O^+ due to ion-molecule reactions prevented good drift-velocity measurements for them, but partial results indicate that O^+ is about 5% faster, and N^+ about 10% faster, than NO^+ in air. N_2^+ is shown to disappear rapidly by charge transfer with O_2. Thus, although the classical value of 1.6 is obtained for the mobility of N_2^+ in air, N_2^+ cannot be present long enough at pressures close to atmospheric to account for the classical observations. (auth)

31618 THEORY OF DISSOCIATIVE RECOMBINATION. Bardsley, J. N. (Univ. of Manchester, Eng.). J. Phys., B, 1: 365-80(May 1968).

It is suggested that there are two distinct modes of dissociative recombination, direct and indirect. The direct mechanism, first described by Bates (1950), involves a single radiationless transition, whereas the indirect mode occurs through an intermediate Rydberg state of the molecule. The recombination rate for ground-state ions should decrease with increasing temperature for both processes, but the rate of decrease is faster for the indirect process. Complete calculations of the recombination rate do not seem possible yet, but it is shown that spectroscopic data can be used to give estimates of these rates. The method is illustrated by a partial calculation of the rate of direct recombination in nitric oxide. (auth) (UK)

31619 CONFIGURATION INTERACTION IN THE CONTINUUM STATES OF MOLECULES. Bardsley, J. N. (Univ. of Manchester, Eng.). J. Phys., B, 1: 349-64(May 1968).

The theory of configuration interaction is discussed in relation to molecular states which have sufficient energy to decay by electron emission or pre-dissociation. By considering the effects of electron emission a resonant scattering formalism is developed which is useful for electron–molecule collisions at very low energies. The application of the theory to pre-dissociation is demonstrated by an analysis of the recent study by Barrow et. al. (Barrow, Chandler and Neyer, 1966, Phil. Trans. R. Soc. A, 260 395-452) of the spectrum of selenium. (auth) (UK)

31620 LINE STRENGTHS IN TWO-ELECTRON SPECTRA. Warner, Brian (Univ. of Texas, Austin). Mon. Notic. Roy. Astron. Soc., 139: 273-82(1968).

There is a continuing need, among astrophysicists engaged in quantitative interpretations of stellar spectra, for oscillator strengths of a reasonably high quality. Configurations which are pure in any one of the coupling schemes LS, LK, j_1K or j_1j_2 are considered. Formulae are given for line strengths of transitions between any two of these configurations. Certain sum rules are presented. Tables of line strengths, restricted to the five most common types of transition of the form np $n'l'$–np $n''l''$, are also given. (auth)

31621 DISTRIBUTION OF THE TRAJECTORY OF PARTICLES SCATTERED WITH ENERGY LOSS IN MATTER. Durand, Alain (Univ., Rennes, France). Compt. Rend., Ser. A and B, 266: 282-4(Feb. 19, 1968). (In French).

The means and the matrix–covariance of the ordinates of the trajectories possible for a particle scattered with energy loss in a block of material (the points and angles of incidence and exit of the particle being fixed) are determined in the small-angle approximation. (tr-auth)

31622 ELASTIC ELECTRON SCATTERING BY MERCURY ATOMS. Buehring, Wolfgang (Univ., Heidelberg). Z. Phys., 212: 61-70(1968).

The cross section and Mott asymmetry function of elastic electron scattering by mercury atoms have been calculated for energies of 46, 79, 100, and 204 keV and the angular range 45°–180°. Some progress in the computational method is reported which remedies the difficulties at backward angles. (auth)

31623 INFLUENCE OF SCREENING ON MOTT SCATTERING BY MERCURY ATOMS. Kessler, Joachim; Weichert, Norbert (Univ., Karlsruhe, Ger.). Z. Phys., 212: 48-60(1968).

Cross sections of elastic electron scattering by mercury nuclei have been measured at energies and angles where the screening of the nuclear Coulomb field by the atomic cloud begins to play a role. Electrons of 46, 79, 100, and 204 keV were scattered by a mercury atomic beam and the angular distribution of the elastically scattered electrons was measured between 45° and 135°. There are considerable discrepancies between the results of theoretical studies which take the influence of screening into account. The present measurements confirm the theoretical results of Lin et al. within the experimental error of about 2%. (auth)

31624 INELASTIC INTERACTIONS OF GAMMA RAYS WITH K-SHELL ELECTRONS. Ghumman, B. S.; Sood, B. S. (Punjabi Univ., Patiala, India). Indian J. Phys., 41: 737-43(Oct. 1967).

The technique of the absolute intensity measurement of K-shell fluorescent radiation by a NaI(Tl) crystal was employed to measure the cross sections of the inelastic interactions of 280-, 662-, and 1250-keV gamma rays with K-shell electrons in lead and gold. The x-ray efficiency of the detector was measured experimentally by comparing the ratio of gamma rays and x rays following internal conversion from ^{198}Au and ^{203}Hg sources. For 280-keV gamma rays, the measured cross sections agree with the known photoelectric cross sections showing that the x rays are produced essentially through the photoelectric interaction. For 662 and 1250 keV, the measured cross sections are somewhat higher than those of photoelectric interaction indicating the contribution of the Compton scattering from K-shell electrons, the integrated cross section of which is estimated to be equal to that from free and stationary electrons. (auth)

31625 SPREADING THE EFFECT OF SPACE CHARGE, OF AN ELLIPTICAL BEAM OF FINITE EMITTANCE. Tanguy, Pierre (Univ., Rennes, France). Compt. Rend., Ser. A and B, 266: 478-81(Feb. 19, 1968). (In French).

The spreading, under the effect of space charge, of a beam with elliptical cross section and with finite emittance was studied. The beam was assumed to be advancing in a slip space. (tr-auth)

31626 CALCULATION OF THE EFFECTIVE CROSS SECTIONS FOR LOSS OF K-ELECTRONS BY FAST HELIUM-LIKE IONS COLLIDING WITH HYDROGEN AND HELIUM ATOMS. Senashenko, V. S.; Nikolaev, V. S.; Dmitriev, I. S. (Inst. of Nuclear Physics, Moscow). Zh. Eksp. Teor. Fiz., 54: 1203-12 (Apr. 1968). (In Russian).

The cross sections for K-electron loss by fast helium-like H^-, ^{0}He, Li^+, and Be^{2+} ions and also by Be atoms colliding with hydrogen or helium atoms is calculated in the nonrelativistic Born approximation for particle velocities lying between $0.6 \cdot 10^8$ and $60 \cdot 10^8$ cm/sec. Simple approximate formulas are derived for the cross section for K-electron loss by arbitrary particles. The results are compared with similar ones for hydrogen-like particles. A theoretical explanation is given of the experimentally observed identity of the mean cross sections for electron loss on the external K- and L-shells for ions with equal ionization potentials. (auth)

31627 DETERMINATION OF ATOMIC SCREENING PARAMETERS. Brandus, L. (Inst. of Physics, Bucharest). Phys. Lett., 27A: 66-8(May 20, 1968).

A method for the determination of atomic screening parameters is considered. (auth)

31628 DETERMINATION OF THE MEAN LIFE TIMES OF ATOMIC STATES. Bakos, Jozsef (Central Physical Research Inst., Budapest). Fiz. Szemle, 18: 100-5(Apr. 1968). (In Hungarian).

After a period of reduced interest for a decade, research on nuclear transitions involving the measurement of the decay time of excited states received a great impetus. Modern electronic measuring devices used at present improve the accuracy of the data. Rare gases, in particular helium, were chosen for the study because they have a relatively simple structure and are easily available in spectroscopically pure form. The direct measurement involved excitation of the desired energy state and determination of the decay curve; the exponent of this curve represents the reciprocal of the mean life time of the excited state. Excitation by means of electrons presents the advantage that it can be easily controlled. A special measuring device was designed and constructed to measure the 4^3S level of helium. The results were evaluated by means of the "maximum likelihood" method. Using 4.7 nsec for the dead time, a value of 67 ± 1.3 nsec was obtained for this state; it agrees with earlier data reported in the literature. (TTT)

31629 ELECTRON CAPTURE OF IODINE IONS BETWEEN 19 AND 55 MeV. Angert, N.; Franzke, B.; Moeller, A.; Schmelzer, Ch. (Univ., Heidelberg). Phys. Lett., 27A: 28-9 (May 20, 1968). (In German).

Cross sections for electron capture of highly charged 19- to 55-MeV iodine ions in nitrogen were measured. For small ionization in the cross sections are smaller than theoretically predicted. (auth)

31630 IMPORTANCE OF EXCHANGE SCATTERING IN DOUBLE IONIZATION OF He ATOMS BY ELECTRON IMPACT. Kang, I.-J. (Southern Illinois Univ., Carbondale); Henneberger, W. C.; Foland, W. D. J. Phys., B, 1: 524-6(May 1968).

For the process $He(1s) + e^-(k_0) \rightarrow He^{2+} + e^-(k_1) + e^-(k_2) + e^-(k_3)$ relations between the direct and the exchange amplitudes, similar to the relation of Peterkop for single ionizations, are given. It is found that each of the two exchange amplitudes contributes to the cross sections as much as the direct amplitude at any energy. (auth) (UK)

31631 PHYSICAL INTERPRETATION OF THE RUNGE–LENZ VECTOR. Dahl, J. P. (Univ. of Copenhagen). Phys. Lett., 27A: 62-3(May 20, 1968).

The Runge–Lenz vector, which is a constant of the motion in the nonrelativistic hydrogen atom, is shown to be a two-body quantity, whose presence can be completely understood within the classical framework of special relativity. (auth)

31632 POLARIZATION OF THE 4^1D–2^1P TRANSITION OF HELIUM EXCITED BY H^+ AND H_2^+ IMPACT. Scharmann, A.; Schartner, K.-H. (Univ., Giessen, Ger.). Phys. Lett., 27A: 43-4(May 20, 1968).

The polarization fraction of the 4^1D-2^1P transition of helium excited by H^+ and H_2^+ impact was measured in the energy range of 100 keV to 1 MeV. (auth)

31633 QUASICLASSICAL APPROXIMATION IN IONIZATION PROBLEMS. Kotova, L. P.; Perelomov, A. M.; Popov, V. S. Zh. Eksp. Teor. Fiz., 54: 1151-61(Apr. 1968). (In Russian).

The development of the complex trajectory technique (description of the tunnel effect in the quasi-classical case with the help of trajectories corresponding to imaginary "time") is reviewed. The following problems are considered: ionization of a bound level in collisions with a charged particle; ionization of atoms by a constant electric field in the presence of a magnetic field; and evaluation of adiabatic corrections to the probability for tunneling through a potential barrier of arbitrary shape. (auth)

31634 ROLE OF BOUND STATES IN MULTI-PHOTON IONIZATION OF ATOMS. Delone, G. A.; Delone, N. B. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz., 54: 1067-8 (Apr. 1968). (In Russian).

Multi-photon ionization of xenon and krypton atoms by the second harmonic of the radiation from a neodymium laser is observed. The results of the experiments show that bound electron states in the atom play an important role in multi-photon ionization. (auth)

31635 SCATTERING OF SLOW NEUTRONS BY GASEOUS METHANE AND INTERMOLECULAR INTERACTIONS. Fulinski, A.; Zgierski, M. Jagellonian Univ., Krakow). Phys. Lett., 27A: 9-10(May 20, 1968).

It is shown that the experimentally observed discrepancy in intensities of translational and rotational peaks in the neutron spectrum of gaseous methane may be connected with the intermolecular interactions within a nonideal gas. (auth)

31636 RELATIVISTIC EFFECTS IN ELECTRON SCATTERING FROM ATOMS. Yates, A. C.; Strand, T. G. (Indiana Univ., Bloomington). Phys. Rev., 170: 184-9(June 5, 1968).

Relativistic and nonrelativistic differential cross sections for argon, krypton, and iodine are computed for the energy range 20 eV to 150 keV. The atomic fields as determined by Clementi (Hartree–Fock) and Liberman (Dirac) are used interchangeably in the two calculations. Contributions to the cross section arising from exchange between incident and atomic electrons are also considered. Relativistic and nonrelativistic comparisons are made, and where available, the experimental data are also reproduced. A number of conclusions regarding relativistic and exchange effects are reached, most noteworthy of which are the low-energy exchange effects. (auth)

31637 DETACHMENT OF ELECTRONS FROM H^- AND O^- NEGATIVE IONS BY ELECTRON IMPACT. Tisone, G. C.; Branscomb, L. M. (Joint Inst. for Lab. Astrophysics, Boulder, Colo.). Phys. Rev., 170: 169-83(June 5, 1968).

The energy range for the electron detachment cross section for H^- has been extended down to 8.4 eV. The absolute cross section for detachment of electrons from atomic-oxygen negative ions has been measured in the energy range 7.1 to 487.1 eV. Results of these measurements are compared with Bethe-Born calculations of the cross section. This calculation with the semiclassical Coulomb correction is in qualitative agreement with the experimental results above 20-eV electron energy for both H^- and O^-, although the energy dependence of the H^- cross section from 100 to 500 eV is not consistent with the slope predicted theoretically for the high-energy limit. (auth)

31638 TESTS OF BORN APPROXIMATION; DIFFERENTIAL AND TOTAL CROSS SECTIONS FOR ELASTIC SCATTERING OF 100- TO 400-eV ELECTRONS BY HELIUM. Vriens, L.; Kuyatt, C. E.; Mielczarek, S. R. (National Bureau of Standards, Wash., D. C.). Phys. Rev., 170: 163-9(June 5, 1968).

The angular dependence of elastic scattering of 100- to 400-eV electrons by helium atoms has been measured for scattering angles of 5° to 30° with a high-resolution electron spectrometer. The observed relative differential cross sections were converted to an absolute basis by measuring their ratio to known cross sections for excitation to the 2^1P state. Integration over angles yielded total elastic scattering cross sections. Large deviations from the Born approximation are found, especially for small electron energies and small scattering angles. Experimental and theoretical results are analyzed and compared in some detail. Exchange and polarization are chiefly responsible for deviations from the Born approximation. The Ochkur (Bonham) approximation is shown to be almost equivalent to the first-order exchange approximation for electron energies of 350 and 500 eV. Analytical series expansions for differential and total Born cross sections are given. Our experimental results are in qualitative agreement with results of earlier experiments, but are quantitatively different and extend to smaller scattering angles. (auth)

31639 ALIGNMENT OF IONIC GROUND STATE OF Xe BY ELECTRON-IMPACT IONIZATION OBSERVED THROUGH EXCHANGE COLLISION WITH THE NEUTRAL METASTABLE STATE. Hadeishi, Tetsuo; Liu, Chung-heng (Univ. of California, Berkeley). Phys. Rev., 170: 145-50(June 5, 1968).

The radio-frequency paramagnetic-resonance method was used to observe the exchange collisions between the singly ionized Xe ground state $^2P_{1/2}$ and the neutral metastable state $^3P_2$. The ionic ground-state and metastable-state atoms are both formed and aligned by unidirectional low-energy high-flux electron-beam impact. The magnetic resonances of even and odd ionic ground-state atoms were observed by monitoring changes in the transparency of the resonance radiation absorbed by the metastable-state atoms. Phenomenological theories are presented which explain the sign of the magnetic-resonance signal of the ionic ground state relative to that of the neutral metastable state, together with independent experimental evidence to support the theories. Conclusive experimental evidence is presented supporting our original assumptions that the ionic ground-state Xe^+ ($^2P_{1/2}$) is aligned by low-energy electron-impact ionization and that such alignment is detectable through the results of exchange collisions with the metastable state. (auth)

31640 EXCITATION OF AUTO-IONIZING LEVELS IN NEON BY ION IMPACT. Edwards, A. K.; Rudd, M. E. (Univ. of Nebraska, Lincoln). Phys. Rev., 170: 140-4(June 5, 1968).

Auto-ionizing states of neutral and singly ionized neon were produced by bombarding neon gas with H^+, He^+, and Ne^+ ions in the 150- to 250-keV energy range. Sixty lines in the electron spectrum were found, of which 43 have been classified into 13 Rydberg series. Ten of these series were previously unreported. Auger electrons from one- and two-vacancy states are also reported. Relative intensities of all transitions are listed. (auth)

31641 MOBILITIES AND REACTION RATES OF NEON IONS IN NEON. Beaty, E. C.; Patterson, P. L. (Joint Inst. for Lab. Astrophysics, Boulder, Colo.). Phys. Rev., 170: 116-21(June 5, 1968).

The mobilities of Ne^+ and Ne_2^+ ions in neon have been measured at 300°K. The mobilities of Ne^+ and Ne_2^+ at low E/p_0 are given by the equations $K(Ne^+) = 4.07[1 + 8.0 \times 10^3\ (E/p_0)^2 + 2.0 \times 10^{-6}\ (E/p_0)^4]^{-1/2}$ and $K(Ne_2^+) = 6.14\{[1 + 8.3 \times 10^{-3}\ (E/p_0)^2]/[1 + 2.0 \times 10^{-3}\ (E/p_0)^2 + 8.4 \times 10^{-6}\ (E/p_0)^4]\}^{1/2}$, with E/p_0 in V/cm torr. The Ne^+ was observed to convert to Ne_2^+ by a three-body reaction with a rate coefficient ranging from about 7×10^{-32} cm^6/sec at E/p_0 = 2.0 V/cm torr to about 5×10^{-32} cm^6/sec at E/p_0 = 6.0 V/cm torr. (auth)

31642 VACUUM ULTRAVIOLET EMISSION PRODUCED BY PROTON AND H-ATOM IMPACT ON H_2. Dahlberg, Duane A.; Anderson, D. Kent; Dayton, Irving E. (Montana State Univ., Bozeman). Phys. Rev., 170: 127-30(June 5, 1968).

The spectrum in the wavelength range 1200 to 1700 Å excited by proton and hydrogen-atom collisions with hydrogen molecules has been investigated under thin-target conditions. The prominent features of the spectrum are bands originating from the B and C states of H_2 and the Lyman α line of atomic hydrogen. Relative cross sections are presented for the emission of Lyman α and the Lyman band emission from the B state of H_2 due to proton and hydrogen-atom impact in the energy range 20 to 130 keV. Absolute values of these cross sections are estimated by comparison with known cross sections for Lyman α. A calculation of the cross section for proton excitation of the sum of the B and C states of H_2 in the first Born approximation is presented and compared with the experimental results for the B state. (auth)

31643 MULTIPLE SCATTERING OF PARTICLES ARRIVING NORMALLY ON THE SIDE OF A METALLIC BLOCK. Durand, Alain (Univ., Rennes, France). Compt. Rend., Ser. A and B, 266: 377-9(Feb. 12, 1968). (In French).

The angular and distance distribution function of particles arriving normally on the side of a metallic block and emerging after scattering on a face perpendicular to the entry face was determined. (tr-auth)

31644 CALCULATION OF THE ELECTRON AFFINITY OF BORON. Schaefer III, Henry F.; Harris, Frank E. (Stanford Univ., Calif.). Phys. Rev., 170: 108-15(June 5, 1968).

Ab initio calculations have been made for the ground states of neutral B and B^- using configuration-interaction wave functions which included the Hartree–Fock configuration, single excitations, and double excitations of the types (1s,2p), (2s,2s), (2s,2p), and (2p,2p). These calculations indicate that B^- is stable and that the electron affinity of B is 0.0028 Hartrees (0.08 eV). Contributions from the omitted types of correlations were investigated by making separate-pair calculations for the (1s,1s) and (1s,2s) pairs. These contributions do not affect the qualitative conclusions. Consideration of the probable errors in the calculations leads to the definite conclusion that B^- is stable and to an estimate of 0.25 eV for the electron affinity of boron. (auth)

31645 EXCHANGE-COLLISION TECHNIQUE FOR THE rf SPECTROSCOPY OF STORED IONS. Major, F. G.; Dehmelt, H. G. (Univ. of Washington, Seattle). Phys. Rev., 170: 91-107(June 5, 1968).

A description is given of a technique, whose application to He^+ has previously been briefly reported, whereby the rf spectrum of field-confined paramagnetic ions in ultrahigh vacuum is observed through spin-dependent collision processes with a spin-polarized beam of neutral particles. A rf electric quadrupole ion trap is used, and a description of the ion motion, based on the adiabatic approximation, is given, including the effect of randomizing elastic collisions with neutral background particles. With particular reference to the $(^3He)^+-Cs$ system, the rate equations for the magnetic sublevel populations for an ion with $I = \frac{1}{2}$, $J = \frac{1}{2}$ are derived under the simultaneous action of spin exchange and spin-dependent charge exchange with an alkali atom. According to these equations, the relative intensities observed in the $\Delta F = 0$ transitions of $(^3He)^+$ indicate that a Cs spin polarization of 0.5 was achieved in the optically pumped atomic beam. The He^+ polarization approached that of the Cs atoms. With on-off modulation of the Cs polarization, a total 2% change in the He^+ lifetime was observed, with a signal-to-noise ratio of 4, in an interaction period having a duration of 0.8 sec, the optimum value for the observed 0.4-sec lifetime against Cs-induced ion loss. In the absence of the beam, the lifetime was 8 sec at a residual pressure of 3×10^{-8} Torr. The $\Delta F = 0$ lines obtained with long integration times had a signal-to-noise ratio which indicated that the $\Delta F = \pm 1$ transitions should be observable, as has since been demonstrated. (auth)

31646 L_2-SUBSHELL YIELD MEASUREMENTS IN ^{240}Pu, ^{236}U, AND ^{234}U. Byrne, J.; Gelletly, W.; Ross, M. A. S.; Shaikh, F. (Univ. of Edinburgh). Phys. Rev., 170: 80-90(June 5, 1968).

The fluorescence, Auger, and Coster-Kronig yields of the L_2 subshells in ^{240}Pu, ^{236}U, and ^{234}U have been determined from measurements on L x-rays emitted following α decay of ^{244}Cm, ^{240}Pu, and ^{238}Pu. The techniques employed include $\alpha-L$ x-ray coincidence counting using a silicon detector and NaI(Tl) crystal, proportional-counter spectrometry and, in the case of ^{238}Pu, the use of a curved-crystal spectrograph. The following results were obtained: ^{240}Pu, $\omega_2 = 0.466 \pm 0.023$, $a_2 = 0.11 \pm 0.08$, $f_{23} = 0.42 \pm 0.08$; ^{236}U, $\omega_2 = 0.535 \pm 0.042$, $a_2 = 0.09 \pm 0.11$, $f_{23} = 0.37 \pm 0.07$; ^{234}U, $\omega_2 = 0.497 \pm 0.035$, $a_2 = 0.07 \pm 0.07$, $f_{23} = 0.43 \pm 0.06$. The measured fluorescence yields show close agreement with those calculated on a semiempirical basis by Listengarten, but the Auger and Coster-Kronig yields are, respectively, much smaller and much larger than predicted. (auth)

31647 X-RAY L EMISSION SPECTRUM OF Ho. Deodhar, G. B.; Singh, R. B.; Varma, P. P. (Univ. of Allahabad, India). J. Phys., B, 1: 479-81(May 1968).

A 40 cm curved mica crystal spectrograph was employed to study the x-ray L emission of the rare earth element holmium. The analysis of the spectrograms showed two new lines at λ 1323.96 x. u. and λ 1340.16 x. u., corresponding to the non-quadrupole transition L_IO_I and the quadrupole transition $L_IN_{IV,V}$, respectively. The transitions $L_{II}O_I(\gamma_8)$, $L_IM_{IV}(\beta_{10})$ and $L_IO_{IV,V}$ reported earlier by Sakellaridis (Sakellaridis, P., 1953, C. R. Acad. Sci., Paris, 236, 1014; 1955, J. Phys. Radium, 16, 271) were confirmed, but the transitions $L_{II}O_{IV}(\gamma_6)$ and $L_{III}O_{IV,V}(\beta_5)$ reported also by Sakellaridis were unconfirmed. (auth)

31648 ANNIHILATION OF POSITRONS FROM POSITRONIUM NEGATIVE ION $e^-e^+e^-$. Ferrante, Gaetano (Univ., Messina, Italy). Phys. Rev., 170: 76-80(June 5, 1968).

Annihilation of positrons from the positronium negative ion is calculated by a Schroeder six-parameter wave function. The calculation yields a lifetime against two- and three-photon annihilation of 5.02×10^{-10} and 5.66×10^{-7} sec, respectively. The first value is considerably better than the one given by Ferrell. It is found that the value of the lifetime against two-photon annihilation falls close to the values observed by Bell and Jørgensen in Cs and K, and by Weisberg and Berko in Rb, i.e., in low-density metals. This fact is considered as partial evidence that in such media the positronium ion may be formed. For the two-photon annihilation, a plot of calculated angular correlation of emitted photons and of the momentum distribution function is reported. The angular-correlation function shows the maximum at $\pi - \theta = 2.0 \times 10^{-4}$ rad, the departure from π being due to the presence of the spectator electron. (auth)

31649 ENERGY CHANGE COLLISIONS BETWEEN ION PAIRS AND THIRD BODIES. Flannery, M. R. (Queen's Univ., Belfast). J. Phys., B, 1: 384-6(May 1968).

The collision integral occurring in the rate coefficient describing the energy change of ion pairs moving in a gas is made available by determining accurate curve fits throughout the region of most physical interest. (auth)

31650 MOBILITY OF PROTONS AND ALPHA PARTICLES IN HELIUM. Dickinson, A. S. (Queen's Univ., Belfast). J. Phys., B, 1: 395-401(May 1968).

The mobilities of alpha particles in helium at temperatures between 10 and 300°K and of protons in helium at temperatures between 1 and 600°K were calculated. Both mobilities remain close to the polarization limit at all temperatures considered. A discussion is presented of the behaviour of the total and viscosity cross sections and, for He^{2+} in He, of the double-charge-transfer cross section. The higher-order corrections to the mobility are evaluated and found to be negligible. (auth)

31651 DOUBLE ELECTRON EJECTION IN THE PHOTO-ABSORPTION PROCESS. Krause, Manfred O.; Carlson, Thomas A.; Dismukes, R. D. (Oak Ridge National Lab., Tenn.). Phys. Rev., 170: 37-47(June 5, 1968). (ORNL-P-3643).

Electrons ejected from neon by Mg K_α and Al K_α x rays from argon by Ti K_α x rays have been studied with an electrostatic energy analyzer. On the low-energy side of the photolines characteristic of single electron emission, discrete peaks and continua are observed which respectively indicate excitation and ionization of a second electron. From these electron spectra, the following probabilities of two-electron transitions are derived (per photo-absorption event): Ne KL: (18.5 ± 1.0)%; Ar KL: (2.5 ± 0.8)%; and Ar KM: (20.7 ± 1.4)%. In about 85% of the double events, both electrons go into the continuum; in about 15%, the less tightly bound electron is promoted to excited discrete states. With the use of single-electron Hartree–Fock wave functions, the theory of electron shakeoff accounts for the observed intensities. The shape of the continuum electron spectra is in fair agreement with theoretical predictions. About 80% of the shakeoff electrons have energies of $0 \leq E \leq E_i$, where E_i is the binding energy of the L or M electron in an atom that lacks one K electron. Consequences of the present study in regard to x-ray and Auger-electron satellites are discussed, and it is found that specific satellites can be associated with specific double-hole configurations. The following relative intensities of K_α satellites were measured for Mg, Al, and Ti: 13%, 8.5%, and 4%, respectively. (auth)

31652 BORN CROSS SECTIONS FOR THE ELECTRON IMPACT EXCITATION OF THE 2 ^1S AND 3 ^1S STATES OF ATOMIC HELIUM. Bell, K. L.; Kingston, A. E. (Univ. of Belfast). J. Phys., B, 1: 521-3(May 1968).

The first Born approximation is used to calculate the cross sections for electron excitation of the ground state of helium to the 2 ^1S and 3 ^1S states. Various ground- and excited-state wave functions are employed, and the calculations are performed using both the length and velocity formulations of the Born approximation integrals. The best differential cross sections for 2 ^1S are in good agreement with the experimental data. Comparison is also made with available experimental total cross section data. (auth)

31653 SYMMETRY PROPERTIES OF THE SPIN–SPIN CONTACT HAMILTONIAN. Armstrong, Lloyd Jr. (Westinghouse Research Labs., Pittsburgh). Phys. Rev., 170: 122-5(June 5, 1968).

The spin–spin contact Hamiltonian has been separated into operators having well-defined symmetry properties. Analysis of the form of the spin–spin contact Hamiltonian shows that fewer symmetry operators are actually required in this separation than would be indicated by simple group-theoretical arguments. Matrix elements of most of those operators are evaluated by considering the Casimir operator Sp_{4l+2}; the remaining operators are evaluated by exploiting a proportionality to matrix elements of the Coulomb operator. (auth)

31654 UPPER- AND LOWER-BOUND ENERGY CALCULATIONS FOR ATOMS AND MOLECULES IN THE THOMAS–FERMI THEORY. Roberts, Robert E. (Univ. of Wisconsin, Madison). Phys. Rev., 170: 8-11(June 5, 1968).

Using simple functions, upper and lower bounds for the Thomas–Fermi energies of atoms and homonuclear diatomic molecules at various internuclear separations are calculated which differ by less than 0.2% in the atomic case and at most by 0.5% for molecules. The calculation verifies that for this model molecules are not stable for short and intermediate nuclear separations. The possibility of a long-range attraction is also examined, and again the conclusions are found to be in agreement with Teller's theorem. (auth)

31655 MATRIX ELEMENTS OF THE SPIN–SPIN INTERACTION FOR THE f^3 ELECTRON CONFIGURATION. Reilly, Edith F. (Frankford Arsenal, Philadelphia). Phys. Rev., 170: 1-7(June 5, 1968).

The spin–spin matrix elements for the f^3 electron configuration are computed by a method developed by Innes and checked by another method developed by Trees. A few irregularities have been noted. (auth)

31656 NEW DIAGRAM LINES IN THE L EMISSION SPECTRUM OF THULIUM. I. GAMMA REGION. Nigam, A. N.; Garg, K. B.; Kapoor, Q. S. (Univ. of Rajasthan, Jaipur, India). J. Phys., B, 1: 492-5(May 1968).

The L emission spectrum of thulium was investigated in the gamma region using a 40-cm curved mica crystal spectrograph of the transmission type. Three new diagram lines at 1246.3, 1283.1 and 1232.4 x. u. were found. The first corresponds to the quadrupole transition $L_I N_{IV,V}(\gamma_{11})$. The other two have been assigned to the forbidden transitions $L_I N_I$ and $L_I O_I$, respectively. Measurements on the previously known diagram lines in this region were compared with those of earlier workers. (auth)

31657 HYPERFINE STRUCTURE OF SEVEN LOW ATOMIC LEVELS IN ^{59}Co, AND THE NUCLEAR ELECTRIC-QUADRUPOLE MOMENT. Childs, W. J.; Goodman, L. S. (Argonne National Lab., Ill.). Phys. Rev., 170: 50-63(June 5, 1968).

The hyperfine structure of the seven lowest atomic levels in ^{59}Co has been examined with the atomic-beam magnetic-resonance technique. Quantitative agreement with earlier measurements is found for those states for which results have been published. All of the results are corrected for the effects of off-diagonal hyperfine interactions, and the effective-operator theory used for the interpretation also takes into account such effects as intermediate coupling, configuration interaction, and relativistic effects. The emphasis is on examining the consistency of the results from state to state. Although a very high degree of agreement between theory and experiment is found, some difficulty is encountered in understanding details of the quadrupole interaction. Values for the quadrupole moment of the ^{59}Co nuclear ground state are determined in each of two electron configurations. The difference between the two values found is well outside experimental error and is presumably due to different Sternheimer shielding in the two configurations. The value found for Q is consistent with earlier determinations and with nuclear theory. Values are given for the electronic g factor in each state examined. (auth)

31658 NEW DIAGRAM LINES IN THE L EMISSION SPECTRUM OF THULIUM. II. BETA-GAMMA REGION. Nigam, A. N.; Garg, K. B. (Univ. of Rajasthan, Jaipur, India). J. Phys., B, 1: 496-8(May 1968).

Using a 40-cm curved mica crystal spectrograph of the transmission type, the beta–gamma region of the L emission spectrum of thulium was investigated. Four new diagram lines at 1439.1, 1489.4, 1331.5 and 1341.6 x. u. were found. The first line corresponds to the dipole transition $L_{III}O_I(\beta_7)$, the next two to the quadrupole transitions $L_{III}N_{III}$ and $L_{II}N_{III}$, respectively, while the last has been assigned to the forbidden transition $L_{II}N_{II}$. Measurements on the previously known diagram lines in the region under study were compared with those of earlier workers. (auth)

31659 HYPERFINE-STRUCTURE STUDIES OF ^{61}Ni, AND THE NUCLEAR GROUND-STATE ELECTRIC QUADRUPOLE MOMENT. Childs, W. J.; Goodman, L. S. (Argonnel National Lab., Ill.). Phys. Rev., 170: 136-40(June 5, 1968).

The hyperfine structure of the four lowest atomic levels of ^{61}Ni has been studied by the atomic-beam magnetic-resonance technique. Agreement between the results and the theory of the hyperfine interaction is good. The importance of taking account of the substantial departure of the atom from the LS limit in evaluating the electric quadrupole moment Q of the ^{61}Ni nuclear ground state is discussed. Values of Q are determined from two different electron configurations; the values obtained differ by only 3%. The result is in agreement with the previous theoretical prediction of Cohen et al. (auth)

31660 CALCULATION OF THE MAGNETIC HYPERFINE STRUCTURE OF THE ^{1}D, ^{3}D, ^{1}F, AND ^{3}F STATES OF ^{7}Li$^+$. Ambry, C. (Paris Univ.); Bessis, N.; Moser, C. M. Phys. Rev., 170: 131-5(June 5, 1968).

The separations of the magnetic-hyperfine-structure levels of the ^{1}D, ^{3}D, ^{1}F, and ^{3}F states of the ion ^{7}Li$^+$ have been calculated taking into account the mixing of singlet and triplet functions which arise from each configuration (1snd) and (1snf) by the spin–orbit and spin–spin interactions of Breit's Hamiltonian and the magnetic interaction between the nucleus and the 1s electron (Fermi-contact term). The electronic wave functions used are linear combinations of Slater determinants built on hydrogenic orbitals. The calculated distribution of levels is in agreement with experimental results and confirms the coupling rules introduced by Herzberg and Moore for the interpretation of the spectra. The calculations predict an apparent hyperfine structure of the singlet states of ^{7}Li$^+$ which is analogous to that observed in the n ^{1}D states of ^{3}He. (auth)

Cosmic Radiation

Refer also to abstracts 31539, 31541, 31695, 31704, 31984, 32054, and 32060.

31661 (MIT-2098-422, pp 1-9) COSMIC RAY GROUP. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science).

Developments in cosmic radiation research at MIT are reported. X-ray astronomy, including balloon, satellite, and rocket experiments, gamma-ray astronomy, interplanetary plasma, and the BASJE air shower program are discussed. Publications are listed. (W.H.K.)

31662 (ORNL-TM-2194) SOLAR NEUTRON TRANSPORT IN THE EARTH'S ATMOSPHERE. Alsmiller, R. G. Jr.; Boughner, R. T. (Oak Ridge National Lab., Tenn.). [1967]. Contract W-7405-eng-26. 31p. Dep. CFSTI.

The neutron flux per unit energy induced in the Earth's atmosphere by solar neutrons has been calculated as a function of atmospheric depth for depths of less than 300 g/cm^2 (30,000 ft). The calculated flux is compared with estimates of the cosmic-ray neutron flux per unit energy, and it is found that for many flares the solar neutron flux per unit energy is sufficiently above the cosmic-ray neutron flux per unit energy to produce a measurable effect at both balloon and aircraft altitudes. (auth)

31663 (SC-T-68-1516) MEASUREMENT OF THE NEUTRON FLUX DURING THE SOLAR ECLIPSE ON NOVEMBER 12, 1966. Cicchini, A. A.; Simionati de Fritz, A. N. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.), from Paper Presented at the International Solar Eclipse Symposium, Brazil, February 5-9, 1968. 20p. Dep. CFSTI.

Measurements are reported of the neutron flux with energies between 0.1 and 10 MeV in the so-called South American anomaly before, during, and after the solar eclipse. The measurements were carried out by means of balloons which reached the maximum altitude of 23,000 m and of an airplane at a height of 9,600 m. No changes were recorded in the mean absorption length or in the atmospheric thickness corresponding to the maximum neutron count during and after the eclipse; the values obtained agreed with those of other researchers at a similar geomagnetic latitude. A decrease of approximately 7% was recorded in the flux of neutrons measured with the detector whose sensitivity extends up to energies of 10 MeV. (auth)

31664 IMPLICATIONS OF THE SMALL OBSERVED ANISOTROPY OF 7.5- TO 45-MeV COSMIC RAYS. Jokipii, J. R.; Parker, E. N. (Univ. of Chicago). J. Geophys. Res., 73: 3367-76(June 1, 1968).

The recent important observation of Rao et al. (1967) of the quiet-time anisotropy of cosmic-ray particles in the 10-MeV range indicates a surprisingly small value, approximately 0.2%. This low value has a number of general implications. It shows either (a) that the ordinary diurnal variation is suppressed at these low energies by gradient drifts, which is in agreement with the low diffusion coefficient across the lines of force deduced from the observed power spectrum of the interplanetary magnetic field fluctuations, or (b) that $\kappa_\perp \cong \kappa_\parallel$ is a consequence of large power at zero wave number in the Fourier spectrum of the interplanetary magnetic field. Further, adiabatic deceleration of cosmic rays in the expanding fields of the wind leads to a radial anisotropy of 1.2 ± 0.3% if it is assumed that the radial gradient of the cosmic-ray density is as large between the Sun and Earth as reported in the vicinity of Earth. The low value of 0.2% observed by Rao et al. indicates that in fact the gradient must be very much less between the Sun and Earth, which in turn implies that the diffusion coefficient for 10-MeV protons between the Sun and Earth must be rather greater (less scattering by magnetic inhomogeneities) than at the orbit of Earth. These two predictions are subject to observational test. (auth)

31665 SEARCH FOR ^{26}Al INDUCED BY COSMIC-RAY MUONS IN TERRESTRIAL ROCK. Tanaka, S.; Sakamoto, K.; Takagi, J.; Tsuchimoto, M. (Tokyo Univ.). J. Geophys. Res., 73: 3303-9 (May 15, 1968).

Terrestrial ^{26}Al produced by cosmic-ray muons has been sought in silicate rock. Aluminum was isolated and purified from tens of kilograms of chert obtained from an area with a low erosion rate. ^{26}Al was counted with a low-level gamma–gamma coincidence spectrometer. The specific activity for the present surface rock has been measured to be (0.02 ± 0.12) dpm/10 kg SiO$_2$, and the specific activity for the rock at a depth of 24 meters of water equivalent, to be (0.00 ± 0.08) dpm/10 kg SiO$_2$. The ^{26}Al activity in terrestrial rocks has been limited to 0.01 dpm/kg SiO$_2$. (auth)

31666 A STORM-TIME INCREASE IN COSMIC-RAY INTENSITY ON MAY 25-26, 1967. Wada, Masami (Inst. of Physical and Chemical Research, Tokyo). Rep. Ionosphere Space Res. Jap., 21: 223-8(Dec. 1967).

Diagrams of the hourly increase in cosmic-ray intensity on May 25 and 26, 1967, are given. (M.O.W.)

31667 RIGIDITY SPECTRUM OF COSMIC-RAY HELIUM NUCLEI. Anand, K. C. (Tata Inst. of Fundamental Research, Bombay); Daniel, R. R.; Stephens, S. A.; Bhowmik, B.; Krishna, C. S.; Aditya, P. K.; Puri, R. K. Proc. Indian Acad. Sci., Sect. A, 67: 138-50(Mar. 1968).

An experiment was carried out using an oriented stack of nuclear emulsions to determine the rigidity spectrum of helium nuclei between 12 and 40 GV, by taking advantage of the variation of the geomagnetic cut-off rigidity in the east–west plane over Hyderabad, India. A total of 2433 identified helium nuclei recorded in the stack was divided into 8 angular intervals in the east–west plane corresponding to 8 different cutoff rigidities. From this the integral fluxes of helium nuclei at the top of the atmosphere were obtained for all 8 rigidity intervals. The vertical flux above an effective threshold rigidity of 16.73 GV was determined with high statistical accuracy and had a value of 15.0 ± 0.5 helium nuclei $(m^2 \cdot sr \cdot sec)^{-1}$. The rigidity spectrum of these nuclei between 12 and 40 GV can be well represented by a power law of the type $N(>R) = 1990\, R^{-1.74 \pm 0.11} (m^2 \cdot sr \cdot sec)^{-1}$ and is the first direct determination so far made in this rigidity region. The differential rigidity spectra of protons, helium nuclei, and S nuclei of cosmic radiation in the vicinity of the Earth at solar minimum (1965) were constructed with the existing world data and it was found that for rigidities ≥10 GV, the three spectra have, within experimental errors, the same slope of 2.6. The ratios P/He and He/S of the differential fluxes were studied as a function of rigidity. It was found that for $R > 2$ GV, the ratio P/He has, within experimental errors, a constant value of 6.3; as for the ratio He/S, it seems that the experimental data above one GV is not inconsistent with a constant value of 14 over the entire rigidity interval considered here. (auth)

31668 ESTIMATE OF THE ENERGY DENSITY OF SUBCOSMIC RAYS FROM MEASUREMENT OF THE ULTRAVIOLET BACKGROUND. Kurt, V. G.; Syunyaev, R. A. (State Astronomical Inst., Moscow. Inst. of Applied Mathematics, Moscow). JETP Lett. (USSR) (Engl. Transl.), 7: 164-7(Mar. 20, 1968).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktisiyu, 7: 215-18(Mar. 20, 1968).

Charge exchange of protons of subcosmic rays on interstellar hydrogen with capture of an electron in the 2p state should lead to emission of L_α quanta of a wavelength that is shifted as a result of the Doppler effect. From measurements of the radiation flux from the Milky Way in the wavelength range 1225 to 1340 Å, made by the Venera research satellites, the upper limit of the energy density of subcosmic rays with energy 25 to 100 keV ($w_1 < 5 \times 10^{-3}$ eV/cm^3) was calculated. The upper limit for subcosmic rays of energies up to ~1 MeV ($w_2 < 1$ eV/cm^3) was estimated. (A.G.W.)

31669 SOME CONSIDERATIONS ON THE MODULATION MECHANISM OF COSMIC-RAY TIME VARIATIONS. Pak, Byung-So (Univ., Uppsala). Acta Univ. Upsaliensis, Abstr. Uppsala Diss. Sci., No. 115, 13p(1968).

A review is given on 3 papers by the author on the following subjects: short-lived Forbush decreases, day-to-day variability of the daily variation of cosmic rays during quiet period of the solar activity, and increased effects and anomalous daily variation during cosmic-ray storms. (Sweden)

31670 STUDY OF PRIMARY COSMIC RADIATION AND ITS INTERACTION IN THE ATMOSPHERE BY MEANS OF SIMULTANEOUS "SPARMO" FLIGHTS MADE DURING MINIMUM SOLAR ACTIVITY. Heristchi, Dj. (Centre National d'Etudes Spatiales, Meudon, France). SPARMO Bull., 2: 1-7; 9-13; 15-65; 67-9; 71-3; 75-125(May 1967). (In French).

Results of balloon experiments, conducted mainly in 1965, at various latitudes and in periods of minimum solar activity are reported. Certain of these were routine, intended to measure, once a month during the IQSY, the intensity of primary cosmic radiation. The other flights took place in the course of organized programs, particularly around the northern auroral zone in order to observe x-ray fallout. The experimental methods used are described. The angular distribution of charged particles at different atmospheric depths for different stations was determined, as well as the intensity in the vertical direction as a function of atmospheric depth. Certain data concerning the photon component, the density of which is important in the atmosphere, are considered. It was found possible to determine the effect of latitude on secondary photons. (IAA)

31671 RESULTS OF MEASUREMENTS OF COSMIC RADIATION IN THE STRATOSPHERE OBTAINED AT SOGRA, USSR, FROM JANUARY 26 TO FEBRUARY 23, 1966. Lasoutine, L. L.; Stoikov, Y. I. (Inst. of Physics, Moscow). SPARMO Bull., 1: 44-50(Nov. 1966). (In French).

Results obtained from 39 sounding balloons fitted with standard apparatus. Graphs are presented which give the intensity of cosmic radiation as obtained by single and double counters, and by a scintillation counter. Results are also tabulated. (IAA)

Direct Energy Conversion

Refer also to abstract 30794.

31672 (AI-Trans-263) ON THE EFFICIENCY OF MHD PROCESSES WITH INJECTION CONDENSATION. Oldekop, W.; Rex, D. Translated for Atomics International, Canoga Park, Calif., from Advan. Energy Convers., 7: 137-57(1967). 30p. Dep. CFSTI. JCL $2.60 fs, $1.10 mf.

An abstract of the original German article appeared in NSA 22: 7190. (M.H.R.)

31673 (JUL-510-TP) ANGEWANDTE MAGNETOHYDRODYNAMIK. HEFT 3. ENTWURF, AUFBAU UND BESCHREIBUNG DER VERSUCHSANLAGE ARGAS. (Applied Magnetohydrodynamics. Part 3. Design, Construction, and Description of the Experiment Site, ARGAS). Bohn, T.; Foerster, S.; Grawatsch, K.; Holzapfel, Chr.; Kolb, G.; Komarek, P.; Noack, G. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Technische Physik). Dec. 1967. 71p. (In German). Dep.

The physical and technical specifications of the research installation were described. The principle of MHD energy conversion was briefly explained. The individual components of the ARGAS—heater, nozzle, channel, diffuser, magnet, heat exchanger, aftercooler, tubing, cesium circuit, compressors, gas purification, vacuum installation, control and monitoring devices, and measurement techniques—are then described in detail. (J.S.R.)

31674 (UCRL-70795) ONE-DIMENSIONAL CALCULATIONS ON A FINITE-LENGTH MHD INDUCTION GENERATOR. Heusinkveld, M. (California Univ., Livermore. Lawrence Radiation Lab.). Apr. 11, 1968. Contract W-7405-eng-48. 41p. (CONF-680704-1). Dep. CFSTI

From Symposium on Magnetohydrodynamic Electrical Power Generation, Warsaw, Poland.

The problem of the finite-length induction converter is solved in the slit-channel approximation, in which the transverse magnetic field does not vary across the gap. The fluid channel is assumed to be infinitely wide, or infinite-conductivity side shorting bars are assumed for a channel of finite width. Slug flow and scalar electrical conductivity of the channel fluid and sinusoidal time variation are assumed. The magnetic pole pieces with infinite magnetic permeability extend from $x = 0$ to $x = l$. The basic equation for the total magnetic induction B_t is deduced from Faraday's law. Equations are obtained for electrical impedance of the excitation winding, hydrodynamic power input, real and reactive electrical power output, and the energy conversion efficiency. Predictions from this analysis are compared with experimental data from a linear converter model. Results of numerical calculations of the problem of a uniform traveling-wave generator of finite length are presented. These results include magnetic field distribution, electrical impedance, and conversion efficiency as a function of magnetic Reynolds number, generator slip, converter length in wavelengths, and end current. The case of the MHD converter in which the magnetic field varies both across the gap and in the downstream direction is then discussed and analyzed. The basic induction equation is deduced and solved in a manner similar to that of the one-dimensional case, giving a qualitative idea of the error incurred in the use of the one-dimensional approximation. (TSS)

31675 PERFORMANCE OF THERMOCHEMICALLY DRIVEN MHD CONVERTERS. Frankenthal, Shimshon (American Science and Engineering Inc., Cambridge, Mass.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 6: 993-1000(June 1968).

A slug model for the MHD pulse generator is presented, and the assumptions inherent in it are discussed. In the limit where magnetic diffusion can be ignored, it is shown that the model is governed by a third-order system of differential equations, which is presented cast in a dimensionless form and analyzed. The dimensionless parameters that determine the performance are defined and employed in cataloguing the various modes of operation of the system. It is shown that unit conversion efficiency is possible for a wide range of combinations of the system parameters. The role of the load parameter (the ratio of the load resistance to the total circuit resistance) in optimizing the performance is discussed. In a particular mode of operation, the compression of the magnetic field by the slug gives rise to the possibility of operating the device at a reasonable conversion efficiency even though the initial (imposed) magnetic field is small. The excitation requirements in this nearly "self-excited" mode are determined by the inductive component of the load. (auth)

31676 TRANSIENT WAVE GROWTH IN MAGNETOGASDYNAMIC GENERATORS. Powers, Walter L. (Univ. of Tennessee, Knoxville); Dicks, John B. AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 6: 1007-12(June 1968).

A first-order perturbation analysis of the continuity, momentum, and energy equations coupled with the generalized Ohm's law permits an investigation of the amplification rates of the transient acoustical response to natural disturbances that may disturb uniform flow conditions in supersonic, constant-area magnetogasdynamic generators. Fluctuations in the electrical conductivity and Hall parameter are primarily responsible for wave growth or decay due to their dependence on the fluctuating gas temperature, pressure, and density. The dispersion relation resulting from a one-dimensional plane wave traveling in the axial direction is a cubic equation with complex coefficients which is solved numerically for a typical set of steady-state operating values, in the diagonal conducting wall, Hall, continuous-electrode, and Faraday generators. In this investigation, 1) the steady-state gradient terms are not neglected, 2) the adiabatic approximation is not made, 3) the cubic is solved numerically rather than by approximate algebraic expressions, 4) solutions are presented for various disturbance wavelengths, and 5) solutions are presented for all operating external resistivities of interest. Results show that under certain operating conditions the upstream and enthalpy modes can obtain energy from the gas, causing considerable increase in their amplitudes during the time they spend in a typical channel. (auth)

31677 GIDRODINAMIKA ZHIDKOMETALLICHESKIKH MGD-USTROISTV. (Hydrodynamics of Liquid Metal Magnetohydrodynamic Devices). Lielausis, O. A. Riga, Izdatel'stvo Zinatne, 1967. 196p.

Liquid metal MHD-installations are reviewed as a variety of hydraulic devices. The principal changes in the metal fluid flow in a constant external magnetic field are analyzed in the first chapter. Hydraulic properties of the flow channel in plane linear electromagnetic pumps are described in the second chapter. The third chapter treats problems of a liquid metal MHD batcher, considering nonstationary hydraulic conditions in which only the pressure initiating metal flow is of electromagnetic origin. In the fourth chapter, liquid metal flow up the open stream is considered. It is observed that even in the strictly magnetodynamics flow the ordinary fluid flow regularities are retained. Electrotechnical calculations are presented in the fifth and last chapter. Induction pumps with a simplified cylindrical hydraulic channel are discussed. Extensive references are included for each chapter. (R.V.J.)

31678 PERFORMANCE CHARACTERISTICS OF A SINGLE-WAVELENGTH LIQUID-METAL MHD INDUCTION GENERATOR WITH END-LOSS COMPENSATION. Cerini, Donald J.; Elliott, David G. (Jet Propulsion Lab., Pasadena, Calif.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 6: 503-10(Mar. 1968).

Experiments were performed on a 1000-W, 700-Hz, constant-velocity, alternating-current magnetohydrodynamic (MHD) induction generator using room-temperature sodium–potassium alloy (NaK) as the working fluid. The purpose of the experiments was to determine the electrical losses and power production in the fluid with a winding of the type expected to provide maximum efficiency in the short generators required for low friction loss in liquid-metal MHD power systems. The winding produced a single-wavelength traveling field together with oscillating compensating fields at each end of the generator to cancel the voltage induced between the conducting side plates by the termination of the traveling field. The efficiency of power generation in the fluid reached 0.54 at a slip s of 0.55, compared with the ideal efficiency $(1 + s)^{-1} = 0.65$ of an infinite-length generator. The compensating fields cancelled the side-plate voltage and reduced the electrical end losses in the fluid by a factor of seven. (auth)

31679 ENERGY CONVERSION. ELECTROMECHANICAL, DIRECT, NUCLEAR. Walsh, Edward M. New York, Ronald Press Co., 1967. 408p.

Electromechanical energy conversion is discussed. Direct thermal-electrical conversion is covered in the topics on thermoelectric conversion, photoelectric conversion, thermionic conversion, fluiddynamic converters, and fuel cells. Nuclear-thermal conversion is reviewed. (M.H.R.)

31680 OPTIMUM ADDED NOBLE GAS PRESSURE IN CESIUM THERMIONIC DIODES. Musa, G.; Popescu, Denisa; Baltog, A. (Inst. of Physics, Bucharest). Rev. Roum. Phys., 13: 73-80(1968).

The addition of the noble gas in the cesium thermionic diode operating in the low-voltage arc mode may improve the output characteristics of the diode. An analytical equation has been derived in order to obtain the optimum value of the noble gas pressure. This value is strongly dependent on the plasma parameters such as electron temperature, charge density, plasma sheath at the emitter edge. The established analytical results are useful for the explanation of the reported data by different authors. They also may be used to choose, for given plasma conditions, the most convenient noble gas and the needed pressure as well as to predict the influence on the output characteristics of the cesium thermionic diode. (auth)

31681 STEADY-STATE, CONTROLLED-DISCHARGE, LINEAR NONEQUILIBRIUM MAGNETOGASDYNAMIC GENERATOR. Evans, Norman A. (General Electric Space Sciences Lab., King of Prussia, Pa.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 6: 394-400(Mar. 1968).

Experimental results are presented which demonstrate the basic feasibility of extracting steady electrical power from a plasma in a state of significant nonequilibrium ionization when flowing at high speed through a magnetic field. The work was carried out in a cesium-seeded argon blowdown facility at a stagnation temperature of 1500°K, Mach numbers up to 0.6, and a magnetic field strength of 22,500 gauss. Each of the eleven channel electrode pairs was equipped with a discharge holder in the form of a small diameter ceramic tube between the electrodes. This device controlled the current path through beneficial interference by acting in a manner analogous to a simple flame holder, producing, especially at the generator entrance, a considerable improvement in both discharge steadiness and voltage efficiency. During uniform Faraday mode power extraction from the last seven electrode pairs the transverse electrical conductivity was approximately 150 times the corresponding thermal equilibrium value, the traversable probe readings showed that the induced Faraday electric field exceeded 90% of the theoretical value. It was concluded that pure magnetically induced ionization is impractical on account of the low ionization is impractical on account of the low ionization rate at temperatures up to 1500°K, and in the present experiment this problem was overcome by the expenditure of appreciable input preionization power through the first four electrode pairs. (auth)

31682 MGD-GENERATORY. (Magnetohydrodynamic Generators). Urusov, I. D. Izdatel'stvo Nauka, 1966. 175p.

The principles of the magnetohydrodynamic method of heat conversion into electric power are described. The magnetohydrodynamic method of energy conversion is referred to as "magnetogas dynamics" (magnitogazodinamika-MGD). By eliminating turbines and generators in magnetohydrodynamic generator and replacing them with heat-resistant ceramic materials, the temperature of gas can be raised to 3000 degrees C which, in turn, will increase the overall efficiency of power installation from conventional 30% to almost 60%. Such an increase in power generation efficiency can be achieved when auxiliary steam turbines utilizing waste heat are added to the installation. This book is of interest to scientific workers, engineers, technicians, and students of colleges engaged in the problem of direct conversion of heat into electric power. (TSS) (JPRS)

Fluid Physics

31683 ON BOUNDEDNESS OF MAGNETOHYDRODYNAMIC FLOWS. II. Arora, Kasturi L. (Punjab Engineering Coll., Chandigarh, India). J. Math. Anal. Appl., 22: 72-91(Apr. 1968).

The boundedness of hydromagnetic flows in an infinitely long cylindrical pipe of arbitrary cross section, with an applied radial magnetic field is discussed. (W.D.M.)

31684 MAGNETOHYDRODYNAMIC WAVE PROPAGATION FROM A LOCALIZED SOURCE INCLUDING HALL EFFECT. Broadbent, E. G. (Royal Aircraft Establishment, Farnborough, Eng.). Phil. Trans. Roy. Soc. London, Ser. A, 263: 119-47 (May 30, 1968).

Lighthill's theorem on magnetohydrodynamic wave propagation from a localized source gives an asymptotic expression for the wave amplitude at large distance from the source and this theorem is applied to a laboratory plasma. Attention is focused mainly on conditions where the Alfvén speed is large compared with the sound speed and where the wave frequency is of the same order as the ion cyclotron frequency. These conditions are also typical of certain natural plasmas. The manner in which the wave amplitude depends on the direction of propagation and on the ratio of the wave frequency to the ion cyclotron frequency is examined and illustrated by graphs which also cover a range of source sizes. An extension is made into a two-fluid theory such that electron inertia and electron source terms can be included and the effect of finite electrical conductivity is considered. (auth)

31685 NUMERICAL EXPERIMENTS ON A MODEL SYSTEM FOR MAGNETOHYDRODYNAMIC TURBULENCE. Thomas, John H. (Univ. of Rochester, N. Y.). Phys. Fluids, 11: 1245-50(June 1968).

A one-dimensional system of equations modeling the incompressible magnetohydrodynamic equations is proposed. Numerical experiments corresponding to the "turbulent dynamo" problem, in the form of a statistical initial-value problem for the model system, are performed. Correlations, energy spectra, and other properties are examined at various times. The advantage of the model system is that no approximation need be made for the nonlinear "transfer" terms whose balance controls the outcome. The results of the experiments are that, for Reynolds number R_m in the range 4 to 20, dynamo action occurs in the model system whenever the magnetic Reynolds number R_m is greater than or equal to R. Dynamo action also occurs in the case $R = 20$, $R_m = 4$, but fails to occur for $R = 20$, $R_m = 0.2$. In all cases where dynamo action occurs, the magnetic energy approaches the equipartition level, sometimes after first overshooting this level by a considerable amount. (auth)

31686 LAMINAR MASS TRANSFER IN A PLANE MHD FLOW IN THE PRESENCE OF ORIENTED TRANSVERSE MAGNETIC FIELD. Blum, E. Ya.; Lisovskaya, S. I. (Inst. of Physics and Power Engineering, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser., No. 1, 75-81(1968). (In Russian).

Data obtained on mass exchange in a stationary laminar magnetohydrodynamic flow of electrolytes in rectangular channels showed that the Hartmann-flattened rate profile concept indicates an increased mass exchange intensity on the walls. The Leveque method was used for developing the expression of Hartmann flow mass exchange. The experimental studies were carried out by electrochemical methods using reversible oxidation–reduction reactions in ferri–ferrocyanides. Theoretical calculations are in agreement with experimental data. (tr-auth)

31687 JOULE'S DISSIPATION OF MAGNETO-HYDRODYNAMIC FLOW IN THE PRESENCE OF CONSTANT TRANSVERSE MAGNETIC FLUX. Grinberg, G. K.; Zander, Yu. K. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser., No. 1, 82-92(1968). (In Russian).

Joule's dissipation of a magnetohydrodynamic channel flow in the presence of a constant magnetic flux of various distributions is studied. It is shown that the heat loss may be decreased by applying inhomogeneous magnetic flux density. (auth)

31688 THE DEFINITION OF NONDIMENSIONAL GROUPS FOR THE SIMILARITY OF MHD PHENOMENA BASED ON THE ANALYSIS OF DIMENSIONS. Ikonnikov, Yu. A.; Krivonishchenko, I. A.; Kropachev, G. P. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 2, 85-92(1967). (In Russian).

Basic dimensionality theory was used in the study of MHD phenomena in liquid metals and alloys. A method is presented for constructing corresponding systems of similarity criteria, and tabulated data are included. (R.V.J.)

31689 THE TURBULENT MHD BOUNDARY LAYER WITH A LONGITUDINAL PRESSURE GRADIENT. Ginzburg, I. P.; Skurin, L. I. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 2, 65-71(1967). (In Russian).

An approximate solution for turbulent boundary layer in a liquid with a constant conductivity in crossed electric and magnetic field was found within the limits of semi-empirical turbulence theory. A general differential equation with a numerical integration suitable for resolving the problem of arbitrary flow rates and magnetic field distribution along the plate was obtained. Certain solutions were found for the equation in a closed form. The obtained theoretical results on the friction coefficient in the MHD channel were compared with the Likadis experimental data. (R.V.J.)

31690 STEADY MHD COUETTE FLOW OF AN ELECTRICALLY CONDUCTING, VISCOUS, INCOMPRESSIBLE RAREFIED GAS UNDER TRANSVERSE MAGNETIC FIELD. Soundalgekar, V. M. (Indian Inst. of Tech., Bombay). Proc. Nat. Inst. Sci. India, Part A, 33: 211-20(July 1967).

An investigation of the combined influence of constant external magnetic field and electric field on the laminar steady Couette flow of an electrically conducting, incompressible, viscous rarefied gas is carried out, in the slip-flow regime. It is found that velocity profiles, velocity gradient at the upper wall, current distribution, slip-velocity, and skin-friction are affected by magnetic field, electric field, and the rarefaction of the gaseous medium. (auth)

31691 LAMINAR CONDUCTING LIQUID BOUNDARY LAYER IN THE PRESENCE OF UNEVEN MAGNETIC FIELD. Yuferev, V. S. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 2, 61-4 (1967). (In Russian).

Two-dimensional laminar boundary layer of conducting fluid flow entering a homogeneous magnetic field distributed perpendicularly to the streamlined surface is analyzed. A solution is obtained for the linearized momentum equations, which were further used for determining the main characteristics of the phenomena taking place in the flow transition area. (tr-auth)

Geophysics

Refer also to abstracts 30786, 31532, and 31539.

31692 (MIT-2241-38) ENERGY BUDGET OF THE STRATOSPHERE DURING 1965. Report No. 21. Richards, Merwin E. (Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology). Dec. 20, 1967. Contract AT(30-1)-2241. 186p. Dep. CFSTI.

A monthly statistical analysis was made of the effects of large-scale horizontal eddy transport processes on the zonal momentum, heat and energy budgets for three layers of the 1965 stratosphere. Geostrophic wind components were computed from IQSY data at 100, 50, 30, and 10 mb for use in calculating the statistical quantities used in the analysis. It was found that temporal and spatial variances and covariances computed from monthly means of temperature and geostrophic wind components give meaningful results when used in the computation of momentum, heat and energy balances. Monthly meridional distributions of eddy transports and energy conversions show large latitudinal and height variations. They also indicate a physically reasonable compatibility with month-to-month changes in zonal mean values of temperature, zonal wind and geopotential. It was further determined that in the winter, the eddies in the middle stratosphere convert a self-contained source of zonal available potential energy into eddy available potential energy. It is speculated that further conversion of this energy eventuates in its availability as a significant source for the mean zonal motions. (auth)

31693 (RSIC-740) LUNAR-SOLAR PERTURBATIONS OF A 24-HOUR SATELLITE. Martynenko, B. K. Translated from Byull. Inst. Teor. Astron., 11: No. 1, 33-47(1967). 32p.

Study of the lunar–solar gravitational perturbations of two hypothetical earth satellites having a sidereal period of $23^h56^m04^s$ is given. The orbit of the first satellite lies in the equatorial plane while that of the second is perpendicular to the ecliptic plane. At the initial moment (12^h E. T., January 1950), the nodes of the orbits of the two satellites and the moon coincide. The perigee distance of the first satellite is chosen so as to minimize the secular excitations of the orbital eccentricity at fixed values of all the remaining elements. The orbital parameters of the second satellite are chosen according to the condition of maximum secular perturbations of the orbital eccentricity. The orbital eccentricity of the first satellite is 0.1, while that of the second is 0.6. Results show that the orbit of the first satellite is stable and orbital eccentricity decreases at the rate of 0.00127 per year. Rapid increase in the eccentricity of the second satellite limits its lifetime to 5.5 years. Secular and periodic first-order perturbations are calculated. (tr-auth)

31694 (UCRL-50368) TIDES IN A NUMERICAL MODEL OF THE ATMOSPHERE. Hardy, John W. (California Univ., Livermore. Lawrence Radiation Lab.). Apr. 18, 1968. Contract W-7405-eng-48. 49p. Dep. CFSTI.

Results from investigation into tidal effects in the LAM code, a numerical model of the atmosphere, are reported. General qualitative agreement with the atmosphere was found. This agreement included the existence of traveling waves and standing waves whose components corresponding to the first three wave numbers had the correct order of magnitude. Some quantitative agreement was also found, for instance, the traveling wave component of the semi-diurnal component has the proper phase. Statistical significance of all results is discussed. Statistical arguments are presented showing that there is a dependence of amplitude and phase of the traveling wave components of the tide upon time. (auth)

31695 CATALOGUE OF DISTURBANCES IN IONOSPHERE, GEOMAGNETIC FIELD, FIELD INTENSITY OF RADIO WAVE, COSMIC RAY, SOLAR PHENOMENA, AND OTHER RELATED PHENOMENA. No. 52. AUGUST 29–SEPTEMBER 4, 1966. Rep. Ionosphere Space Res. Jap., 21: 257-307(Dec. 1967).

31696 A ROCKET OBSERVATION OF [0I] 5577 A EMISSION AND CONTINUUM AT 5300 A IN NIGHT AIRGLOW. Huruhata, M. (Tokyo Astronomical Observatory); Nakamura, T.; Steiger, W. R. Rep. Ionosphere Space Res. Jap., 21: 229-32(Dec. 1967).

A set of five photoelectric photometers was used to observe night airglow and stellar background. Intensity of the 5577 Å line is plotted with height. (M.O.W.)

31697 TEMPORARY RADIATION ZONES CAUSED BY GEOMAGNETIC STORMS. Takao, Kazuki; Nakadan, Yasuhiro (Kyoto Univ.). Rep. Ionosphere Space Res. Jap., 21: 203-11(Dec. 1967).

Anomalous radiation zones were observed when the authors were monitoring solar radiation by real-time telemetry of the satellite Explorer 30. From their spectra, the radiation is concentrated in the 0 to 8 Å band if it is x radiation. The radiation zones seem to appear in the later period of the main phase of severe magnetic storms, and show remarkable dependence on geomagnetic latitude in the range of 40 to 60°. These facts lead one to consider that the radiation has a strong relation with energetic particles, which may come from normal radiation belts. The x-ray sensors of the satellite scanned the source with certain directivity and showed that the radiation has considerable anisotropy, and also that the satellite encountered the radiative zone at a height of 700 to 900 km. (auth)

31698 VLF DOPPLER EXPERIMENT FOR OBSERVATION OF THE IONOSPHERE BY MEANS OF ROCKET. Kimura, Iwane (Kyoto Univ.). Rep. Ionosphere Space Res. Jap., 21: 173-85 (Dec. 1967).

A vlf Doppler experiment by a rocket is described. A ground signal transmitted at 40 kc was received by the rocket, to observe the nighttime ionosphere. A convenient technique using a sonagraph was adopted in order to measure easily the Doppler beat frequency. The observed result indicates that there was a deep trough in the electron density around 130 km altitude, and the maximum electron density in the F2 region was identical with that obtained by vertical sounding near the Kagoshima Space Center. From the frequency of the beat signal, the polarization of the wave could be determined and it was found that reversal of the polarization took place at the altitude where the plasma frequency was equal to the wave frequency. (auth)

31699 QUADRUPROBE FOR DC ELECTRIC FIELD MEASUREMENT IN SPACE. Oya, Kiroshi (Kyoto Univ.). Rep. Ionosphere Space Res. Jap., 21: 193-202(Dec. 1967).

Two fundamental difficulties in dc electric field measurements in space, $v \times B_0$ generation and contact potential effects have been discussed. To eliminate all these disturbances, a new dc electric field probe, called the "Quadruprobe" has been proposed. The feasibility of electric field measurement by this probe is investigated from the standpoint of the theoretical base on the electrodynamics for moving systems and the technological possibility. It is confirmed that two pair of probes, in which one pair detects the dc electric field in plasma media while the other pair is able to measure that in dielectric media, are quite effective for an induction ($v \times B_0$) free observation. A practical design of quadruprobe instrumentation is carried out for an experiment which will be made in the near future by an ionospheric sounding rocket. (auth)

31700 ELECTRIC CURRENTS IN THE IONOSPHERE OF THE POLAR CAPS. Lebeau, Andre; Mendel, Annick. Compt. Rend., Ser. A and B, 266: 642-6(Mar. 4, 1968). (In French).

The integrated density of the horizontal current at the zenith of the observatories studied was obtained from the mean hourly values of the horizontal component of the magnetic field. The analysis was made for nine arctic and antarctic stations. (J.S.R.)

31701 DETERMINATION OF THE TEMPERATURES OF H^+ IONS BEGINNING WITH PROTON WHISTLERS. Quemada, Daniel (Faculte des Sciences, Orsay, France); Velut, Pierre-Marie; Vigneron, Jacques. Compt. Rend., Ser. A and B, 266: 636-8(Mar. 4, 1968). (In French).

After a critical study of the determination method of the proton temperatures in the ionosphere, given by Gurnett and Brice, a new method was developed, beginning with a more rigorous theoretical study. This method leads to results in agreement with other experimental determinations. (tr-auth)

31702 METHOD FOR MEASUREMENT OF DRIFT IN THE LOWER IONOSPHERE. Sengupta, P. R. (Indian Inst. of Tech., Kharagpur). J. Inst. Telecommun. Eng., 12: 55-60(1966).

A method for determining the direction and speed of drift in the lower ionosphere is described. The spaced receiver technique originated by Mitra was utilized for this purpose with the modification that the pulsed transmitter was done away with. In this method the signal from Radio Tashkent (164 kc) was received at Delhi on two receivers placed at a distance of 8 km from each other. Properly oriented loop aerials of the Belrose type eliminated the ground wave from the received signal. The amplitude of the received signal was continuously recorded at the two receivers after appropriate synchronization. The fading patterns obtained on two charts were similar but showed a relative displacement along the time axis. Assuming one-hop propagation, it was possible to calculate the component of the ionospheric drift at the reflecting layer along the specified direction. This method can be a very useful one in determining the drift system in the lower ionosphere if a system of three spaced receivers is used. (Indian Sci. Abstr.)

31703 ROCKET STUDIES OF FAR-ULTRAVIOLET RADIATION IN AN AURORA. Miller, R. E. (Johns Hopkins Univ., Baltimore); Fastie, W. G.; Isler, R. C. J. Geophys. Res., 73: 3353-65(June 1, 1968).

Auroral spectra were obtained in the wavelength region 1050 to 1550 A over the altitude range 90 to 160 km in an Aerobee rocket at Fort Churchill, Manitoba. Spectral lines of atomic hydrogen, nitrogen, and oxygen, and eighteen bands of the Lyman–Birge–Hopfield system of molecular nitrogen were identified. The primary electron flux and the 3914-A emission of N_2^+ were also measured throughout the flight. Altitude profiles for several spectral features and the electron flux are given, and correlations among the various observations are discussed. The hydrogen Lyman-α radiation at 1216 A was found to be independent of the aurora. Other origins for this radiation are suggested. (auth)

31704 RING CURRENT EFFECTS ON COSMIC RAYS. Yoshida, S.; Akasofu, S.-I.; Kendall, P. C. (Univ. of Alaska, College). J. Geophys. Res., 73: 3377-94(June 1, 1968).

During geomagnetic storms, there occurs an increase of cosmic-ray flux, superposed on the well-known Forbush decrease, although the increase, in general, is rather hard to detect by a casual inspection of cosmic-ray records. By carefully eliminating the Forbush decrease, it is shown that the time variation of this increase closely follows the storm-time variation of $D_{st}(H)$, which is an approximate measure of the intensity of the ring current field. For storms with a weak D_{st} decrease, the increase is small or absent, regardless of the magnitude of the Forbush decrease. By using a model ring current that takes into account the three adiabatic motions of ring current particles, it is shown that the observed increase can be reasonably explained. Further, it is suggested that a large asymmetry of the storm-time cosmic-ray increase is caused by the asymmetry of the ring current. (auth)

31705 OCCURRENCE OF SPORADIC E IN THE POLAR CAP. Baird, G. A. (Bartol Research Foundation, Swarthmore, Pa.). J. Geophys. Res., 73: 3505-10(June 1, 1968).

The variations in the occurrence, amplitude, and duration of sporadic E events observed by two very-high-latitude forward scatter networks were analyzed. It was found that for both networks the most of the E_s propagation is associated with events that last longer than one hour. On the other hand, there are differences in the occurrence patterns between the two networks. The results are discussed in terms of particle precipitation into the polar cap. (auth)

31706 SUNRISE BEHAVIOR OF THE F LAYER AT MID-LATITUDES. Evans, J. V. (Massachusetts Inst. of Tech., Lexington). J. Geophys. Res., 73: 3489-3504(June 1, 1968).

Measurements of the F-layer electron and ion temperatures during the predawn and sunrise periods for February and March 1967 are presented. These were obtained, using the Millstone Hill Thomson scatter radar (42.6°N 71.5°W). By limiting the observations to a fixed altitude (375 ± 40 km), it has been possible to make repeated measurements at short time intervals (6 minutes). From these data one is able to recognize instances of conjugate point heating of the local ionosphere. These are observed in March (and October) but give rise to only small temperature increases in contrast to stations at lower latitudes. This difference is attributed to the lower rate at which the Sun rises at the conjugate point and the high predawn values of electron temperature (and hence thermal conductivity), maintained in the local ionosphere by the cooling of the protonosphere. The rapid increase in electron temperature at local sunrise was examined and compared with the behavior of the electron concentration at this time. It was found that initially the electron temperature rises rapidly and that the electron concentration decreases. The electron concentration begins to rise only after the electron temperature has been rising for about 30 minutes. This behavior lends support to the idea that F-region loss rates increase rapidly with increasing electron temperature. Based upon this dependence and the effects of conjugate point heating, it becomes possible to explain two additional sunrise anomalies observed at midlatitudes, namely (1) the seasonal variation of dN_{max}/dt, and (2) the seasonal variation in the delay that follows ionospheric sunrise before N_{max} begins to increase. (auth)

31707 EVIDENCE OF NONFISSION ELECTRONS IN THE SOUTH ATLANTIC ANOMALY. Marbach, James R.; Warren, Carlos S.; Lindsey, Reed S. (Manned Spacecraft Center, Houston, Tex.). J. Geophys. Res., 73: 3477-81(June 1, 1968).

The flux-energy spectrum of electrons trapped on L shells of 1.23 to 1.38 R_E was measured on the manned Gemini 12 mission as it passed through the South Atlantic anomaly region. The energy range covered was 0.41 to 4.66 MeV. Above approximately 1 MeV, the spectrum follows that of decayed fission electrons with a decay constant consistent with previous measurements. Below 1 MeV, the spectrum shows a sharp increase with decreasing energy. It is postulated that the spectrum shape is caused by natural electrons and that the flux of fission electrons has decayed sufficiently to allow a clear determination of the nonfission component of the spectrum. (auth)

31708 USE OF IONIC MOBILITIES FOR MEASUREMENTS IN THE LOWER IONOSPHERE. Keller, George E. (Army Ballistic Research Lab., Aberdeen Proving Ground, Md.). J. Geophys. Res., 73: 3483-8(June 1, 1968).

The results of recent laboratory investigations indicate that attempts to use ionic mobilities for the identification of positive ions in the lower ionosphere must necessarily fail. A mobility determination requires ion–molecule collisions; chemical reactions occurring during these collisions will cause each mobility spectrum to tend toward a continuum. Because these reactions do not change the total number density of ions, conductivity measurements can be made using an average mobility for ions in air. (auth)

31709 SPECTRAL MEASUREMENTS OF AURORAL-ZONE PARTICLES. Chase, L. M. (Univ. of California, Berkeley). J. Geophys. Res., 73: 3469-76(June 1, 1968).

Electron and proton detectors covering the energy range 1 to 300 keV were flown on rockets to an altitude of 240 km at Fort Churchill, Canada, during particle precipitation events. Flights were made during the day and at night. The main results were: (1) the electrons at 0° pitch angle having energy 1 to 5 keV were present with nearly constant intensity during a rocket flight. The 5- to 20-keV electron flux increased by a factor of 10 in 50 seconds and the 80- to 160-keV electrons increased by a factor of 100 in 50 seconds. (2) On one occasion microbursts (rapid increases in electron flux of about 0.6-second duration) were detected in the 80- to 160-keV and 160- to 320-keV electrons, while no rapid variations occurred in the 1- to 20-keV range. (3) In the day flights, a peak was found in the electron energy spectra between 2 and 5 keV. The average flux over this interval was 6×10^7 $(\text{cm}^2 \text{ ster sec keV})^{-1}$. (4) During the night, the spectral peak was between 5 and 20 keV, and the average flux was 1.6×10^8 $(\text{cm}^2 \text{ ster sec keV})^{-1}$. (5) The slope of the electron energy spectrum above 20 keV was much steeper at night than during the day. (6) The largest proton flux appeared in the 0.75- to 1.5-keV interval and reached 2×10^6 $(\text{cm}^2 \text{ ster sec keV})^{-1}$. (auth)

31710 UNIVERSAL-TIME CONTROL ON THE LOW-ENERGY ELECTRON FLUXES IN THE POLAR REGIONS. Maehlum, Bernt N. (Rice Univ., Houston, Tex.). J. Geophys. Res., 73: 3459-68(June 1, 1968).

Particle observations by the Rice University/ONR satellite Aurora 1 have revealed a large universal-time variation in the low-energy electron fluxes in the northern polar region during summertime. The electron fluxes are highest near 1800 to 2000 UT, both on the night- and the day-side of the earth above ~75° invariant latitudes, whereas a minimum in the fluxes is reached between 0600 and 1200 UT. It is suggested that these variations are associated with the diurnal changes in the tilt of the geomagnetic axis relative to the solar wind direction. (auth)

31711 RAPID INCREASES IN THE PROTON AND ELECTRON FLUXES IN THE MAGNETOSPHERE. Konradi, Andrei (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 73: 3449-58(June 1, 1968).

Three rapid increases in the low-energy electron (20 to 100 keV) and proton (>100 keV) flux were observed on October 27, and December 1, 1961. The increases were marked by a drastic change in the intensity and/or spectrum of the measured radiation during a 2- to 3-minute interval. The time histories of the intensities and spectra are presented. The close association between the events and the occurrence of polar substorms is shown. The similarity of the events and those of December 20, 1962, and April 15, 1965, is discussed. It is also shown that the October 28, 1961, event is consistent with adiabatic acceleration of particles during a storm sudden commencement. (auth)

31712 B–L SPACE AND GEOMAGNETIC FIELD MODELS. Lindstrom, Peter J.; Heckman, Harry H. (Univ. of California, Berkeley). J. Geophys. Res., 73: 3441-7(June 1, 1968). (UCRL-17492).

Geomagnetic field models in B–L space for $0.20 \leq B \leq 0.24$ gauss and $1.2 \leq L \leq 1.8$ R_E were intercompared. Three field models were selected because of their general usage in the analysis of trapped radiation data: Jensen and Whitaker (569 coefficient); Jensen and Cain (48 coefficient); GSFC (9/65) (99 coefficient). These models were compared with the GSFC (12/66) field model (120 coefficient). The geographic coordinates of constant B–L traces were computed, using the GSFC (12/66) field in both the southern and northern hemispheres. At each geographical point along the traces thus defined, B and L values were recalculated, using different geomagnetic field models. It was found that variations in B–L space of the 48- and 569-coefficient models with respect to the 120-coefficient model are great enough to cause significant ambiguities in flux contours of the trapped radiation. The effects of temporal variations of the geomagnetic field on B–L space were also examined. The uncertainties in the proton flux contours in B–L space caused by errors in the field models and time variations of the geomagnetic field demonstrate the need for careful re-evaluation of existing data that pertain to possible time variations of inner-belt protons. The GSFC (12/66) appears to be sufficiently accurate to undertake such re-evaluation. (auth)

31713 SUDDEN IMPULSES IN THE GEOMAGNETOTAIL. Patel, V. L. (Univ. of Denver). J. Geophys. Res., 73: 3407-19(June 1, 1968).

Magnetic field observations made by IMP 1 satellite were used to study sudden impulses (si) in the magnetospheric tail. A total of seven si's that are correlated with the satellite data in the tail were observed terrestrially. Large and well-defined si's in the surface magnetograms show definite correlation with the tail field. However, not all sudden changes observed in the tail field have associated si's. The characteristics of these observed si's are discussed, and velocities of the propagation in the tail from 870 to 1300 km/sec are obtained. There is an indication that some of the sudden impulses were originated in the tail and propagated to the surface of the Earth. Also, in some events the sudden impulses originated on the sunward side of the magnetosphere and propagated into the tail. Possible mechanisms for the generation of the si's are discussed. Two events of micropulsations associated with the sudden impulses are also found. In one case, the propagation of these micropulsations from the tail to the earth's surface appears to have been confined to 10° longitudinal range. (auth)

31714 EFFECT OF THE INTERPLANETARY FIELD ON THE ENERGY OF GEOMAGNETIC DISTURBANCES. Maguire, John J. (Boston Coll., Chestnut Hill, Mass.); Carovillano, Robert L. J. Geophys. Res., 73: 3395-3405(June 1, 1968).

The calculation of the energy of confinement of a shielded magnetic dipole field is reformulated in terms of the concept of flux linkages. By means of this approach an important theorem relating to magnetic storms can be generalized. In addition, the interaction of the interplanetary magnetic field with the magnetopause is considered in the limits of negligible and complete merging. An upper limit on the amount of energy available for particle energization in the magnetosphere is thereby determined analytically and is computed, using characteristically observed magnetic field amplitudes. A method is developed for determining directly from the data the amount of merging that occurs at the magnetopause. (auth)

31715 DISCUSSION OF PAPER BY E. N. PARKER, "CONFINEMENT OF A MAGNETIC FIELD" BY A BEAM OF IONS. Ferraro, V. C. A.; Davies, Christine M. (London Univ.). J. Geophys. Res., 73: 3605-7(June 1, 1968).

In a recent paper Parker (1967) suggested that if the solar wind has a component of velocity parallel to the geomagnetic field there will be no equilibrium confinement of the geomagnetic field unless the electron pressure is greatly enhanced. This suggestion is discussed and objections are raised. A reply by Parker is included. (W.D.M.)

31716 RADIO-STAR VISIBILITY FADES IN ALASKA NEAR SOLAR MINIMUM. Fremouw, Edward J. (Univ. of Alaska, College); Lansinger, John M. J. Geophys. Res., 73: 3565-72 (June 1, 1968).

Quantitative results for 49 visibility fades observed from College, Alaska, during 1965 are presented. A majority of the fades revealed ionospheric optical depths in excess of unity at 68 MHz. Optical depth is numerically equal to mean-square fluctuation in r-f phase across a plane at the base of the scattering region; thus, the fades often were characterized by rms phase deviations in excess of one radian at 68 MHz. The wavefront phase structure immediately after scattering was found to have scales in the range of tens and hundreds of meters. The observations usually were not consistent with the demands of a Gaussian autocorrelation function, as is commonly assumed. Rather, the perturbed wavefronts displayed evidence of quasi-periodic structure in the observed dimensional range. (auth)

31717 LOW-ENERGY ELECTRON FLUXES AT LATITUDES ABOVE THE AURORAL ZONE. Burch, James L. (Rice Univ., Houston, Tex.). J. Geophys. Res., 73: 3585-91(June 1, 1968).

Preliminary analysis of data from the satellite 1967–65B (Aurora 1) indicates that a region of low-energy electron fluxes ($50\ \text{eV} < E < 10\ \text{keV}$) exists poleward of the auroral zone at invariant latitudes of 73 to 82° near magnetic local noon and midnight. Spacecraft transit across the high-latitude boundary of the auroral zone is nearly always evidenced by a sudden spectral softening and the onset of pronounced spatial or temporal anisotropy. This pattern is observed in both the northern and southern polar regions. The interface between the two zones undergoes a diurnal variation in invariant latitude that approximates that of the high-latitude "trapping boundary" for electrons of energies > 35 keV and of the visual auroral zone for the magnetic local times investigated. (W.D.M.)

31718 PROTON GYROFREQUENCY BAND EMISSIONS OBSERVED ABOARD OGO 2. Guthart, H.; Crystal, T. L.; Ficklin, B. P.; Blair, W. E.; Yung, T. J. (Stanford Research Inst., Menlo Park, Calif.). J. Geophys. Res., 73: 3592-6 (June 1, 1968).

Preliminary results of OGO 2 measurements of electromagnetic emissions in the vicinity of the proton gyrofrequency were obtained. The emissions were analyzed from two sources of data: the sweep-frequency receiver PCM data, showing the noise amplitude–frequency spectrum, and the Rayspan special purpose data, showing the frequency-time spectrum. The emissions are characterized by a noise band whose sharp lower cutoff frequency is within 10% of the local proton gyrofrequency and whose upper cutoff frequency varies with magnetic latitude and can be as high as an order of magnitude above the proton gyrofrequency. The first 100 revolutions, during which OGO 2 was Sun acquired, were studied. (W.D.M.)

31719 ULTRAVIOLET DAYGLOW MEASUREMENT WITH THE X-15 AIRCRAFT. Doherty, L. R. (Univ. of Wisconsin, Madison). J. Geophys. Res., 73: 3597-8(June 1, 1968).

From filter photographs with peak sensitivity at 2470 Å and bandwidth 1700 Å, the daytime zenith sky brightness was measured at an altitude of 75 km. It was found that a B3 star with apparent visual magnitude 7.6 should produce the same response at λ 2500 as one square minute of arc of the sky above 75 km. (W.D.M.)

31720 DISCUSSION OF PAPER BY YOJI KONDO AND JAMES E. KUPPERIAN, JR., "INTERACTION OF THE NEUTRAL HYDROGEN AND CHARGED PARTICLES IN THE RADIATION BELTS." THE CONSEQUENT LYMAN-ALPHA EMISSION. Eather, R. H. (Rice Univ., Houston, Tex.). J. Geophys. Res., 73: 3599-3601(June 1, 1968).

A recent paper in this Journal [Kondo and Kupperian, 1967] sought to explain a directional variation in night-sky H Ly α by H^+–H interactions in the radiation zone. Two objections to the proposed explanation are discussed. A reply by Kondo and Kupperian is included. (W.D.M.)

31721 DISCUSSION OF PAPER BY I. LERCHE, ON THE "BOUNDARY LAYER BETWEEN A WARM, STREAMING PLASMA, AND A CONFINED MAGNETIC FIELD." Hurley, James P. (Univ. of California, Davis). J. Geophys. Res., 73: 3602-4(June 1, 1968).

In a recent article by Lerche (1967) an argument was presented to show that it is unlikely that a plasma can be confined by a magnetic field if the plasma has a component of velocity parallel to the magnetic field. An objection is raised to this argument and a brief discussion is given. A reply to this objection by Lerche is presented in some detail. (W.D.M.)

31722 MEASUREMENT OF PHASE VARIANCE AND AUTOCORRELATION DURING RADIO-STAR VISIBILITY FADES. Fremouw, Edward J. (Univ. of Alaska, College). J. Geophys. Res., 73: 3557-64(June 1, 1968).

An experiment is described that allows quantitative interpretation of radio-star visibility fades in terms of the variance and one-dimensional autocorrelation function of radiowave phase immediately after scattering in the ionosphere. The technique allows determination of these two parameters as dynamic quantities, but time resolution is limited to the order of ten minutes. An observational example is presented. (auth)

31723 COMPARISON OF SEVERAL PROBE TECHNIQUES FOR IONOSPHERIC ELECTRON CONCENTRATION MEASUREMENTS. Heikkila, W. J. (Southwest Center for Advanced Studies, Dallas); Eaker, N.; Fejer, J. A.; Tipple, K. R.; Hugill, J.; Schneible, D. E.; Calvert, W. J. Geophys. Res., 73: 3511-35(June 1, 1968).

Daytime and nighttime rocket flights up to 150-km altitudes were used to compare several types of probes for ionospheric studies. Absolute measurement of electron concentration was achieved by means of a resonance relaxation probe that detected resonant plasma oscillations excited by a radio-frequency pulse. By comparison with this measurement it was demonstrated that the susceptance curve of an 11.4-cm sphere shows a sudden change in slope at the electron plasma frequency. The mutual admittance between two separate probes proved to be more dramatic, showing distinctive minimums at the several plasma resonance frequencies. On the other hand, the most obvious feature of both the self and mutual admittance curves is a resonance that occurs at a frequency between the electron gyrofrequency and the upper hybrid frequency; the resonance rectification effect occurs at the same frequency. This frequency is determined in a large part by the ion sheath and is not particularly suitable for electron concentration determinations. The high-frequency capacitance of a spherical probe is also strongly influenced by the sheath, but in a manner that can be taken into account empirically; this capacitance can therefore be used as the basis for a practical probe with good sensitivity and resolution. (auth)

31724 MODE CONVERSION AND REFRACTION EFFECTS IN THE EARTH–IONOSPHERE WAVEGUIDE FOR VLF RADIO WAVES. Wait, James R. (Inst. for Telecommunication Sciences and Aeronomy, Boulder, Colo.). J. Geophys. Res., 73: 3537-48 (June 1, 1968).

An approximate theory of multimode propagation in a nonuniform curves terrestrial waveguide is presented. The starting point is the calculation of the mode conversion in a waveguide with an abrupt change of reflecting height and wall impedance. The extension to cascaded sections is then developed. Other approaches are also considered. Finally, some attention is paid to the influence of the angle between the direction of propagation and the terminator (i.e., the sunrise or sunset line). Although no detailed comparison between theory and experiment is made, the results are compatible with much of the observational data reported in the literature. (auth)

31725 CORRECTION OF Pc 1 MICROPULSATIONS AT SPACED STATIONS. Manchester, R. N. (Univ. of Newcastle, New South Wales). J. Geophys. Res., 73: 3549-56(June 1, 1968).

Equipment recording Pc 1 micropulsations has been established at two Australian stations, separated in latitude by 1200 km. Analysis of about seven months of data has shown that Pc 1 activity was recorded about the same amount at each station and that most large-amplitude events occurred simultaneously at the two stations. Cross-correlation analysis of the envelopes of bandpass filtered amplitude-time records has shown that the event propagation velocity is generally directed toward the equator and is inversely proportional to f_0F_2. A number of events having simultaneous propagation both toward and away from the equator have been observed. An improved method of computing the characteristics of hydromagnetic wave propagation in the ionospheric duct is presented, and the experimental results are discussed with reference to the theoretical calculations. (auth)

31726 CORRELATIONS BETWEEN IONOSPHERIC PHENOMENA AND THOSE OBSERVED IN LABORATORY. Ionescu, Theodor V. (Univ., Bucharest). Rev. Roum. Phys., 13: 67-71 (1968).

It is shown that the critical frequencies observed on some ionograms coincide with the frequency spectra due to the negative unstable molecular ions of oxygen. The ionograms obtained on the occasion of the nuclear explosions in the Novaya Zemlya island are analyzed, taking into account the presence of the negative ions of oxygen. The variation of the pressure and temperature produced by the shock wave in the Lindau region is computed. (auth)

31727 MODEL FOR THE EVOLUTION OF STRONTIUM AND LEAD ISOTOPES IN A DYNAMIC EARTH. Armstrong, Richard Lee (Yale Univ., New Haven). Rev. Geophys., 6: 175-99(May 1968).

Contrasting interpretations of existing models of Sr and Pb isotope evolution can be eliminated with a model in which crustal material is recycled through the mantle. In this model the earth's crust and upper mantle (above approximately 500 km depth) are in a steady-state system, and the volumes and bulk compositions of ocean, continent, and mantle have been nearly constant for at least the last 2.5 b.y. and probably for most of the earth's history. Sialic material is continuously eroded from continents into ocean basins and, as a consequence of this process, is isotopically homogenized. In continental-margin orogenic belts and island arcs, the ocean basin, rise, and trench sediments are dragged into the mantle. Isotopic equilibration between sialic and simatic material takes place within the mantle, and the sialic material is returned to the continents or island arcs as juvenile-appearing volcanics, thus completing the geochemical cycle. Most of the radioactive parent isotopes reside within the continental sial, whereas the mantle remains depleted and unable to sustain its observed isotope evolution. With this model it is possible to explain Pb isotope evidence of widespread ancient continents and common Pb evolution in a system which appears to have a very uniform U/Pb and Th/U ratio, even though most of the U and Th are highly enriched in the heterogeneous sialic crust. At the same time the model provides an explanation for Sr isotope evidence of continual addition of material to continents. Sr isotope evolution is dominated by the reservoir of Sr in the mantle; in contrast, Pb isotope evolution is dominated by isotopic mixing during erosion and sedimentation. The apparent differences in the evolutions of Sr and Pb isotopes are due to differing responses to various parts of the steady-state cycle as a consequence of the differences in parent-to-daughter ratios in the sialic crust as compared with the upper mantle and in the degree of enrichment of parent and daughter products in the crust. Identical mathematical models may be used to describe the evolution of both isotope systems. (auth)

31728 ABSORPTION OF ELECTROMAGNETIC WAVES IN THE LOWER IONOSPHERE. Bencze, Pal; Marcz, Ferenc (Geophysical Research Lab., Sopron, Hungary). Fiz. Szemle, 18: 106-8(Apr. 1968). (In Hungarian).

In the lower portion of the ionosphere, up to a height of 150 km, collisions between electrons and neutral particles predominate; when studying the upper portion of the ionosphere, collisions between electrons and ions must also be taken into account. Measurement of the electromagnetic waves as the result of the damping losses of oscillations yields valuable information on the parameters involving the ionosphere. The A3 method developed by K. Spenger and E. A. Lauter was used to determine the absorption of radiowaves reflected by the ionosphere in the intermediate and long wavelength regions. Measurement of the absorption in the lower ionosphere was carried out at the observatory near the community of Nagycenk, making use of the signals emitted by the Budapest (539 kHz) and Ceskoslovensko (272 kHz) senders. The mean absorption values obtained were used to plot the monthly median values. The results revealed that at 539 kHz, the largest of damping losses occurs during the winter months, although the absorption of the abnormal component of the waves is still considerable during the summer. (TTT)

31729 SOLAR WIND AND THE EARTH'S TAIL. Hedervari, Peter. Fiz. Szemle, 18: 36-40(Feb. 1968). (In Hungarian).

According to Fesenkov's theory, the approximately 100,000 km long "tail" of particles behind the Earth's hemisphere opposite the Sun is created by the radiation pressure from particles within the terrestrial exosphere. Later it was assumed that corpuscular particles of solar origin play an important role in the formation of the tail. The density and the velocity of the particles were found to depend on the state of activity of the Sun, such as sunspots and flares. The flow of solar particles was designated by Parker as the solar wind. The velocity of particles in the solar wind varies between 250 and 800 km sec^{-1}; values of 500 and 400 km sec^{-1} were obtained by measurements with Mariner-2 and Explorer-18 satellites, respectively. During periods of intense sunspot activity, values of 1000 and even 2000 km sec^{-1} were measured. As a result of the solar wind, the terrestrial magnetic field becomes asymmetric, resulting in the deformation of the Van Allen belt. The magnetosphere of the Earth at the side opposite to the Sun extends to great distances, creating the magnetic tail of the Earth, exhibiting similarities with comets. The equatorial glow is due to the activity of the electrons in the tail; this glow was photographed by the astronauts of Gemini-5. (Review article). (TTT)

31730 MAGNETOSPHERE. Bencze, Pal; Vero, Jozsef (Inst. of Geophysics, Sopron, Hungary). Fiz. Szemle, 18: 65-9(Mar. 1968). (In Hungarian).

While reviewing the correlation of physical phenomena between the Sun and the Earth, an attempt was made to evaluate the rate of propagation in interplanetary space of factors which affect terrestrial events, examining their effect on the upper portion of the Earth's atmosphere, as it may be observed from the surface of the Earth. The high-energy particles cause polar cap absorption which in turn effect a decrease of the extraterrestrial rf radiation, as observed on the Earth. Another type of activity is related to the 27-day periodicity of magnetic activity. The equilibrium of the magnetosphere is disturbed by inhomogeneities in the solar wind. Analysis of the horizontal component of the Earth's magnetic field intensity revealed stages designated as "disturbance corpuscular flux" and "sudden commencement" followed the "disturbance ring current" which results in the decrease of the field intensity of the equatorial circular magnetic current. The effect of these factors on the creation of the radiations belts around the Earth is examined. (TTT)

Low-Temperature Physics

Refer also to abstracts 30747, 30753, and 32594.

31731 (COO-1112-158) ASPECTS OF THE THEORY OF ELECTRONS IN LIQUID HELIUM. Wang, Shou-yih (Michigan Univ., Ann Arbor). 1967. Contract AT(11-1)-1112. 80p. Dep. CFSTI.

Thesis.

Some aspects of the theory of electrons in liquid helium are reported. The bubble model for the electron is described, in which the electron sees a spherical square well potential of finite depth in the liquid helium. The Wigner-Seitz model is employed in determining the barrier height for the electron. A systematic, self-consistent calculation of bubble parameters is presented. Since the surface tension is required to determine the size of the bubble and since the surface tension is not known, this question is left open. The photoejection cross section as a function of photon energy has been calculated for the process of photoejection of electrons from the bubble states. This cross section is found to be a sensitive function of bubble size. The theory of phonon-bubble scattering is presented, using the self-consistent calculation of the bubble parameters. The relevant cross section including resonant phenomena is calculated. The expression for the phonon-limited mobility of the negative ion has been derived both from Arkhipov's approach and from the Boltzmann Equation with the same result. Comparison of the theoretical results with experimental data indicates a bubble radius over 20 Å at zero external pressure. (auth)

31732 (NP-17482) MAGNETIZATION IN SUPERCONDUCTING FILMS. Note No. 159. Di Castro, C.; Tombesi, P.; Young, W. (Rome Univ. (Italy). Istituto di Fisica). Feb. 13, 1968. 23p. Dep.

The magnetization as a function of the magnetic field has been studied for films of thickness l much less than the coherence distance ξ. The framework used is the pairing model with specular boundary conditions. For sufficiently low temperature and not-too-thin film the magnetization as a function of the magnetic field is shown to have a metastable branch corresponding to a similar branch in the order parameter Δ. A first-order phase transition is present in this case. At higher temperature or thinner films the magnetization is single-valued and goes continuously to zero. A second-order phase transition occurs. The critical field behaves like $l^{-1/2}$ for very thin films $[l \lesssim a(\xi/K_F)^{1/2}]$ and like $l^{-1/2}$ for thicker films $[l \gtrsim a(\xi/K_F)^{1/2}]$. The weak field susceptibility in the first case has an l^3 dependence whereas there is an l^5 dependence in the second case. The results appear to agree with available experimental results. (auth)

31733 (ORNL-TM-2233) MAGNETIC FLUX FLOW AND SUPERCONDUCTOR STABILIZATION. Quarterly Report, January 1–March 31, 1968. Gauster, W. F.; Efferson, K. R.; Hendricks, J. B.; Kroeger, D. M.; Lubell, M. S.; Simpkins, J. E. (Oak Ridge National Lab., Tenn.). May 1968. Contract W-7405-eng-26. 47p. Dep. CFSTI.

The observations on the flux flow and stability performance of bare NbTi strips have been extended to include two additional compositions, viz Nb-5% Ti and Nb-10% Ti, which have similar critical temperatures but widely different upper critical fields and normal state resistivities. The results obtained with these samples confirm our previous conclusion that heat transfer phenomena rather than electrical effects (or a fortuitous interaction between electrical and heat transfer) were of primary importance in understanding premature take-offs. These results agree well with the observation on temperature fluctuations as described below. It has also been shown that the analysis of the field dependent recovery power can yield the heat flux as a function of temperature for the film boiling regime. To improve the analysis on compound conductors, it is necessary to make direct measurements of the magnetoresistance of the stabilizer and of the critical temperature of the superconductor. A new environmental test cell constructed for this purpose is described. Additional heat transfer measurements have been performed and reproducible fluctuations in the temperature of the heated sample in nucleate boiling have been observed. They increase in magnitude with the power dissipation and with the height of the liquid helium column above the sample. In the helium bath itself (without operating probes) temperature fluctuations are likewise observed. They are at least two orders of magnitude smaller and they also increase in magnitude with the height of the helium column. Finally, as anticipated, the thin film work has proved to be a useful tool for the manufacturing of new heat transfer probes. (auth)

31734 (UCRL-18179) SOLENOID HAVING A HORIZONTAL AXIS AND A ROOM-TEMPERATURE APERTURE. Meuser, Robert B.; Chamberlain, William H.; Hintz, Ronald E. (California Univ., Berkeley. Lawrence Radiation Lab.). Apr. 1968. Contract W-7405-eng-48. 18p. (CONF-680505-3). Dep. CFSTI.

From 2nd International Cryogenic Engineering Conference, Brighton, England.

A solenoid having a horizontal axis and room-temperature aperture has been built. The overall length is 43 inches and the clear bore diameter is 4.25 inches. It contains 38,770 turns of Nb–48% Ti wire having a 0.015-inch-diameter core and a 0.030-inch-diameter copper sheath. At the quenching current of 111 A, which is within about 10% of the short-sample value, the current density, based on the coil envelope, is 16.6 kA/cm², and the peak field is 65.5 kG. (auth)

31735 POSSIBLE MECHANISM OF SUPERCONDUCTIVITY. Kresin, V. Z. (Moscow State Correspondence Teacher's Inst.). pp 152-6 of Problema Mnogikh Tel i Fizika Plazmy. Bonch-Bruevich, V. L. Moscow, Izdatel'stvo Nauka, 1967. (In Russian).

A new mechanism of superconductivity is considered. The effective electron–electron attraction is due to interaction with the molecules which are dissolved in the crystalline lattice (inclusion compounds) or are adsorbed on the surface of the sample. In the latter case surface superconductivity becomes possible. In conducting molecular crystals the attraction is due to the electron interaction with crystal molecules. The effective electron–electron interaction is the change of virtual quantum of vibrational motion of the molecules. It is important that $\Delta E_{vib} \gg k\theta$. The effect of dissolving or of adsorption of molecules on the T_c of oridnary superconductors is investigated. (auth)

31736 PROPERTIES OF ABNORMAL SUPERCONDUCTORS. Geilikman, B. T.; Kresin, V. Z. (Inst. of Physics and Tech., Moscow). pp 144-51 of Problema Mnogikh Tel i Fizika Plazmy. Bonch-Bruevich, V. L. Moscow, Izdatel'stvo Nauka, 1967. (In Russian).

The electron–phonon interaction in the abnormal superconductors (Pb and Hg) cannot be regarded as a weak one. The relationship between $\Delta(0)$ and T_k was determined. The Frölich model is considered, the terms of T_k/ω_0 (ω_0 is maximum energy of phonon) being taken into account. (TSS)

31737 WORD-ORGANIZED SUPERCONDUCTING CONTINUOUS-FILM MEMORY. Goser, K. (Siemens AG, Munich). Elektron. Rechenanlagen, 9: 253-60(Dec. 1967). (In German).

A continuous-film memory cell offering a simpler geometry with only two lines and a greater operating range than the previously known continuous-film memory cell with three lines is described. The experimentally determined operating range is so large in comparison with the spread of the operating parameters on a matrix that a realization of a cryogenic continuous-film store may be feasible. The experimental results of small word-organized memory matrices are discussed, and the outlines of large matrices are given. Redundant cells that are automatically selected instead of the faulty cells are provided on the memory matrices, so that not all the cells have to switch. An associative memory is proposed for this selection. (IAA)

31738 SUPERCONDUCTING CONTINUOUS-FILM MEMORY CELLS. Kadereit, H. G. (Siemens AG, Munich). Elektron. Rechenanlagen, 9: 261-71(Dec. 1967). (In German).

The operating conditions and the design of cells with a nondestructive readout for use in associative memories were investigated. The magnetic field penetrating the memory plane of cryogenic continuous-film memory cells is studied by observing the phase transition of thin superconducting films. This method allows the observation of small and slow flux changes such as the penetration, migration, and elimination of lines of flux of opposite polarity. Experimental tests are described, indicating that effects of this kind cause flux degradation by half pulses. This method can also be used for nondestructive readout of continuous-film memory cells and for comparison between stored and applied information. Memory cells of this kind are recommended for use in associative memories. The operating mode of these cells is explained, experiments concerning the operating range of the cells are outlined, and the structure and operating mode of an associative memory with superconducting continuous-film memory cells are described. (IAA)

31739 SPIN–LATTICE RELAXATION PROCESSES IN TYPE-II SUPERCONDUCTORS. Goldberg, I. B.; Weger, M. (Hebrew Univ., Jerusalem). J. Phys. Soc. Jap., 24: 1279-80(June 1968).

The spin–lattice relaxation times of vanadium–titanium and niobium–zirconium alloys were measured as a function of temperature at several magnetic fields in the superconducting phase. It was found that above 1/4 T_c the temperature dependence is according to the BCS theory, while for lower temperatures, the relaxation rates are faster and are proportional to the magnetic field. Extrapolating $1/T_1$ to H = 0 gives the expected BCS values. This behavior is accounted for by the presence of fluxoids in the metals. Also, from the experimental results the coherence lengths can be estimated. (auth)

31740 FLUX FLUCTUATIONS AND CRITICAL CURRENTS IN A SUPERCONDUCTING RING NEAR T_c. Lukens, J. E.; Goodkind, J. M. (Univ. of California, San Diego, La Jolla). Phys. Rev. Lett., 20: 1363-5(June 10, 1968).

Measurements of current fluctuations and critical currents as a function of temperature have been made in a ring of superconducting tin with a current resolution corresponding to about 0.1 quanta of magnetic flux in the cylinder and a temperature resolution of a few microdegrees. The fluctuations occur between neighboring quantum states at a rate which increases rapidly with increasing temperature. The critical currents do not follow the dependence predicted by theory. (auth)

31741 ENERGY BUILDUP FACTORS IN BARRIER GEOMETRY. Golub, V. V.; Panchenko, A. M. At. Energ. (USSR), 24: 71-3(Jan. 1968). (In Russian).

The information in the literature on buildup factor for isotropic point sources refers to the case where the source and point of detection lie on a straight line normal to the barrier. However, in practice it is frequently necessary to know the buildup factors for the case where the point of detection is shifted a certain distance with respect to normal. Buildup factors for iron and aluminum barriers were measured for isotropic point sources having gamma energies of 0.661 and 1.25 MeV. At barrier thicknesses of about one mean free path length it was observed that the buildup factor increased with increasing displacement distance $\mu\rho$ and with decreasing energy of the primary gamma quantum. The observed discrepancy was particularly noticeable for Al barriers. Thus at a barrier thickness $\mu d = 1.35$ and a gamma energy of 0.661, the buildup factor for a point shifted by an amount $\mu\rho = 10$ was a factor of 3 smaller than the buildup factor for a barrier of the same thickness. The data can be represented by the following empirical formula for an Al barrier: $B_f(\mu\rho,\mu d) = B_f(\mu\rho) - \mu\rho[k_1 - (k_1/k_2)\mu d][\mu\rho - \mu d]$. Here B_f is the buildup factor for an infinite barrier and a point isotropic source; $k_1 = 0.24$ and $k_2 = 20$ at $E_\gamma = 0.661$ MeV; $k_1 = 0.15$ and $k_2 = 7$ at $E_\gamma = 1.25$ MeV. (TTT)

31742 LIQUID-HELIUM GREEN'S FUNCTIONS NEAR THE LAMBDA TRANSITION. Byckling, Eero (Univ. of Minnesota, Minneapolis). Contract AT(11-1)-1569. Ann. Phys. (N. Y.), 47: 1-14(1968).

The renormalized equations for the thermodynamic potential A and the Green's functions G_ν of the degenerate interacting boson system are studied in the limit of small condensate density. Assuming that for a small positive $\epsilon = T - T_\lambda$ scaling-law-type asymptotic forms $\Sigma(0,0) - \mu \propto \epsilon^\sigma$, $\Sigma(k,0) - \Sigma(0,0) \propto (\epsilon^{2\nu} + k^2)^{1-\eta/2}$, $\partial^2 A/\partial\sigma_{\xi}^2 \propto \epsilon^\gamma$ are realized, neglecting the class $K^{(2)}$ of 2-irreducible graphs, and taking leading terms in entropy, it is found that $\gamma = \min(\sigma, \nu(2 - \eta))$. The relation of σ to the other critical indices is found, and yields the equation $\gamma = (2 - \eta)/(1 + \eta)$. (auth)

31743 TOMASCH OSCILLATIONS IN THE DENSITY OF STATES OF SUPERCONDUCTING FILMS. Wolfram, T. (North American Rockwell Corp., Thousand Oaks, Calif.). Phys. Rev., 170: 481-90(June 10, 1968).

The mechanism that gives rise to the oscillatory structure in the quasi-particle density of state of superconducting films with spatially varying electron–electron interaction is discussed. It is shown that the Tomasch effect results from processes in which a quasi particle is condensed into the sea of Cooper pairs, leaving behind a different but degenerate quasi particle. The tunneling density of states is obtained for a composite two-region superconductor. The nature of the density-of-states structure depends strongly upon the ratio of the energy gaps of the two regions. In the low-energy range, bound eigenstates characterized by the quantization of the difference of the momenta of the degenerate quasi particles are found for infinite mean free path. Explicit results are presented for the composite film systems In–Al and In–Pb for several values of the electron mean free path. (auth)

31744 IMPURITY SCATTERING IN SUPERCONDUCTORS. Gruenberg, L. W. (Massachusetts Inst. of Tech., Cambridge. Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., 170: 491-5(June 10, 1968).

The effect of impurity scattering on the free energy of a superconductor is calculated by means of a straightforward application of thermodynamic perturbation theory. It is shown that in the vicinity of the transition, it is necessary to take into account second-order terms in the impurity concentration, even in the very dilute limit. These corrections are calculated with the aid of a variational technique. The resulting modification in the transition temperature and thermodynamic properties are in agreement with those obtained using the Green's-function technique, provided the impurity concentration is sufficiently small. (auth)

31745 ELASTICITY EFFECTS IN TYPE-II SUPERCONDUCTORS. Labusch, R. (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 170: 470-4(June 10, 1968). (NYO-3029-22).

A phenomenological theory of strain and stress effects in Ginzburg–Landau superconductors is given. The theory provides formulas for the elastic constants and the specific volume in the mixed state, and it is shown how to obtain a complete set of appropriate phenomenological parameters. Correct expressions for the interaction energy between fluxoids and localized strain fields, which are only partly in agreement with the expressions used by previous authors, are also obtained. (tr-auth)

31746 STABILITY LIMITS OF THE MEISSNER STATE AND THE MECHANISM OF SPONTANEOUS VORTEX NUCLEATION IN SUPERCONDUCTORS. Kramer, L. (Stanford Univ., Calif.). Phys. Rev., 170: 475-80(June 10, 1968).

The limits of metastable existence of the superconducting Meissner state in a magnetic field are found by examining the second variation $\delta^2\Omega$ of the Ginzburg–Landau free energy. No assumptions about boundary conditions are made, and all possible fluctuations are examined. First, confining the fluctuations to one dimension, it is shown that $\delta^2\Omega$ is positive definite exactly up to that field H_{s2} (first calculated by Ginzburg) at which the Meissner state ceases to exist as a Ginzburg–Landau solution. At H_{s2}, the normal state penetrates spontaneously. Then arbitrary fluctuations are taken into account and it is shown that for superconductors with $\kappa \gtrsim 0.5$ another instability occurs at a lower field H_{s1}, leading to a new metastable modification of the Meissner state. This new state possesses small vortices with fluxoid quantum zero along the boundary, and is metastable up to a field H_{s3}, which is probably of the order of $H_{s2}(H_{s3} = H_c$ for $\kappa \gg 1)$. At H_{s3}, the normal state penetrates. Then, in a type-II superconductor with H_{s3} smaller than the upper critical field H_{s2}, spontaneous nucleation of Abrikosov vortices will take place in the normal region without violating fluxoid quantization. This should be the correct mechanism for vortex nucleation in ideal superheating experiments. (auth)

31747 NEW ECHO PHENOMENA IN SUPERCONDUCTORS AND IN NORMAL METALS. Alloul, H.; Froidevaux, C. (Faculte des Sciences, Orsay, France). Phys. Rev. Lett., 20: 1235-6 (May 27, 1968).

Echo phenomena were observed in normal and superconducting powdered metals. They are believed to be related to magnetoacoustic modes. (auth)

31748 EFFECT OF DISPERSED PRECIPITATION ON THE CRITICAL CURRENT DENSITY IN ZIRCONIUM–NIOBIUM ALLOYS. Bychkov, Yu. F.; Goncharov, I. N.; Mal'tsev, V. A.; Petrova, L. V.; Tokarev, M. N.; Khukhareva, I. S. Fiz. Metal. Metalloved., 25: 45-51(Jan. 1968). (In Russian).

It was shown that the increase of the critical current density can cause the formation of dispersed precipitation in the undeformed matrix. The dispersed precipitation has a much lower critical temperature than the original alloy. (tr-auth)

31749 INJECTION OF ELECTRONS INTO He II FROM AN IMMERSED TUNGSTEN FILAMENT. Spangler, Glenn E.; Hereford, Frank L. (Univ. of Virginia, Charlottesville). Phys. Rev. Lett., 20: 1229-30(May 27, 1968).

Tungsten filaments have been operated while immersed in He II at temperatures up to 2500°K, and electron currents as high as 0.5 μA have been produced in the superfluid, yielding densities of at least 10^9 negative ions/cm^3. The fluid in the vicinity of the filament remains quiescent under these conditions as a result of a stable vapor film which forms around the filament. (auth)

31750 ATTENUATION OF CURRENT IN A SUPERCONDUCTING RING UNDER THE INFLUENCE OF A LOW-FREQUENCY MAGNETIC FIELD. Odenov, S. V.; Shukhman, V. A. (Inst. of Physics, Tbilisi, USSR). JETP Lett. (USSR) (Engl. Transl.), 7: 125-7(Mar. 1968).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 7: 163-5(Mar. 5, 1968).

Experiments were performed with a Pb ring in the presence of an external homogeneous magnetic field $H_=$ perpendicular to the plane of the ring. An alternating magnetic field of amplitude $h_\sim$ perpendicular to the plane of the ring was applied to the constant field for a fixed time. Attenuation of the current in the ring was observed at total field values corresponding to the region near the end of the linear section of the magnetization curve of the ring. The character of the attenuation depends on the relation between $h_\sim$ and $H_=$. The maximum relaxation times reach ~1 hr; the relaxation times decrease with increasing total field. The results may possibly be attributed to the fact that the total magnetic field exceeds the critical value in certain regions on the surface contributing to the creating of n regions. The resistive effect can arise only as a result of continuous motion of such regions. (A.G.W.)

31751 INFLUENCE OF NEUTRON IRRADIATION AT 4.6°K ON THE SUPERCONDUCTING PROPERTIES OF NIOBIUM. Berndt, H.; Kartascheff, N.; Wenzl, H. (Zentralinstitut fuer Tieftemperaturforschung der Bayer, Munich. Technische Hochschule, Munich). Z. Angew. Phys., 24: 305-13(May 1968). (In German).

The magnetization properties and the electrical resistivity of pure superconducting niobium wire samples (resistivity ratio 800) have been studied in a longitudinal magnetic field as a function of reactor irradiation at 4.6°K and subsequent annealing treatment. The irradiation induced a magnetic hysteresis depending on the irradiation dose; the upper critical field H_{c2} increased linearly with the normal resistivity $\rho_n(\partial H_{c2}/\partial \rho_n = 1.56$ kOe/$\mu\Omega^-$cm) in agreement with theory. The pinning force f_p exerted by the defect clusters on the flux lines has been determined by minor magnetization loops. The pinning force f_p as a function of the neutron dose Φt shows a maximum ($f_{p\,max} \sim 10^{-3}$ dynes/cm) at a dose of $\Phi t \sim 3 \times 10^{18}$ n/cm^2. The peak effect has been observed in all irradiated the same resistivity change. The mean pinning force on 1 cm flux line per defect cluster is of the order of 10^{-7} dynes. The residual resistivity change $\Delta\rho_n$ shows a tendency towards saturation with irradiation. The extrapolated saturation value of $\Delta\rho_n \sim 3\ \mu\Omega^-$cm is in agreement with deuteron irradiation experiments. (auth)

31752 PHOTOSENSITIVE TUNNELING AND SUPERCONDUCTIVITY. Giaever, Ivar (General Electric Research and Development Center, Schenectady, N. Y.). Phys. Rev. Lett., 20: 1286-9 (June 3, 1968).

If two conductors are separated by a sufficiently thin, evaporated CdS film, the observed tunnel current through the CdS film may be modulated by exposing the sample to a light source. If both conductors are metals in the superconducting state, it is possible to switch the CdS into a resistanceless state, the Josephson state, by exposing it to a light source. (auth)

31753 STRUCTURE IN THE TUNNELING DENSITY OF STATES OF SUPERCONDUCTING La. Rogers, J. S.; Khanna, S. M. (Univ. of Alberta, Edmonton). Phys. Rev. Lett., 20: 1284-6(June 3, 1968).

Structure has been observed in the tunneling characteristics of La thin-film diodes which may be attributed to a poorly developed phonon spectrum in the portion of the La film sampled by the experiment. (auth)

31754 EFFECT OF NIOBIUM ON THE SUPERCONDUCTING PROPERTIES OF ALLOYS WITH ZrV_2 AS A BASE. Alekseevskii, N. E.; Guseva, L. N.; Matveeva, N. M. (Baikov Inst. of Metallurgy, Moscow). Dokl. Akad. Nauk SSSR, 175: 1047-50(Feb. 11, 1968). (In Russian).

The effect of Nb on the properties of ZrV_2 was investigated at two compositions. Composition I was selected by replacing vanadium atoms by niobium atoms, and Composition II was chosen by holding the Zr content constant at 33.3 at. %. According to x-ray data, the ZrV_2 compound formed γ-solid solutions with niobium with a cubic $MgCu_2$ structure. Replacement of vanadium atoms by niobium atoms led to an increase in lattice period and a decrease in the superconducting transition temperature T_k. Replacement of the sum of the atoms (2V + Zr) by niobium atoms did not cause any change in the lattice period of the γ-solid solution. The superconducting transition temperature also remains practically unchanged. A homogeneous equilibrium alloy having a composition ZrV_2 had a higher superconducting transition temperature (9.64°K) than a cast alloy of the same composition (8.0°K). A new ternary phase (δ) with the compound $ZrV_{1.5}Nb_{0.5}$ as a base was shown to have a hexagonal crystal structure of the $MgZr_2$ type and a superconducting transition temperature of 4.30°K. (TTT).

31755 HEAT TORQUES AND CIRCULATION IN SUPERFLUID HELIUM. Hunt, T. K. (Ford Motor Co., Dearborn, Mich.). Phys. Rev., 170: 245-8(June 5, 1968).

The small torques experienced by heated cylinders immersed in rotating superfluid helium have been measured and the results are compared with the predictions made for "heat-exchange" torques by Penney and Overhauser. They have pointed out that whenever there is a net superfluid circulation about a heated object, the object should experience a torque proportional to the circulation and power input and inversely proportional to the absolute temperature. The measured torques show this expected dependence on power and temperature. The existence of such torques is inherent in the two-fluid thermohydrodynamics of He II and is a result of the transfer of superfluid angular momentum to the object as superfluid is converted to normal fluid at the heated surface. Torques of order 10^{-6} to 10^{-7} dyn cm are observed at 1.30°K for power inputs of a few milliwatts and for cylinders 2 mm in diameter and 1 cm long. If the superfluid circulation is quantized, as first suggested by Onsager and Feynman, the torque should also be quantized. The torque values measured in the present experiment correspond to those expected for a few quanta of circulation about the cylinder, but the present experimental noise levels do not permit clear resolution of individual quantum levels. (auth)

31756 LIQUID ^{3}He. I. CALCULATION OF THE BINDING ENERGY FROM TWO BODY CORRELATIONS. Oestgaard, E. (Princeton Univ., N. J.). Contract AT(30-1)-937. Phys. Rev., 170: 257-72(June 5, 1968). (PUC-937-287).

The method of Brueckner and Gammel is used to solve the Bethe–Goldstone equation, calculate the reaction matrix or G matrix, and then get the two-body interaction energy contribution. The Brueckner–Gammel method is studied in some detail. For simplicity we use the approximation of an effective mass in a reference energy spectrum, which in principle should be fitted to self-consistent single-particle energies. The intermediate-state potential energies are, however, chosen to be equal to zero. Hence, the three-body energy contribution must be estimated by separate calculations. Various two-body wave functions, Fourier transforms of wave functions, and G-matrix elements are calculated. Also, the volume of the correlation hole, which gives the convergence parameter in the linked-cluster expansion, and an effective interaction, which is a representation of the G matrix in coordinate space, are calculated, together with the binding energy for liquid ^{3}He. The calculations are repeated for various input parameters, i.e., for several values of the parameters which define the reference energy spectrum, and for several values of the initial relative momentum of the two interacting particles. The total or cm momentum is set equal to zero. The Brueckner–Gammel method is found to be a fairly rapid and convenient method when the complete Green's function in the Bethe–Goldstone equation is expressed in terms of a corresponding reference-spectrum Green's function, and the single-particle energies in the energy denominator in the Bethe–Goldstone equation are replaced by a reference energy spectrum. Third-order and higher-order energy contributions can probably be assumed to be built into this energy spectrum, or they may be estimated by separate calculations. The binding energy for liquid ^{3}He with only two-body terms included is found to be approximately $-\frac{1}{2}$°K per particle, which is in general agreement with other calculations. (auth)

31757 DYNAMIC NUCLEAR POLARIZATION OF LIQUID ^{3}He BY OPTICAL PUMPING. McAdams, H. H. (Rice Univ., Houston, Tex.). Phys. Rev., 170: 276-85(June 5, 1968).

Experiments are described wherein optical pumping of room-temperature ^{3}He gas in diffusive contact with ^{3}He liquid at 0.93°K yields dynamically enhanced nuclear spin polarization in the liquid. Steady-state polarization of 0.085% has been observed in a 20-mm^3 liquid sample, and transient polarization of 0.15% has been achieved in a 2-mm^3 sample. Using the same technique, 2% polarization was achieved in dense ^{3}He gas at 4-mm Hg pressure and 0.93°K. The experiments were performed in an applied magnetic field of about 8 G, corresponding to a thermal equilibrium polarization of 7×10^{-5}%. An equation is derived to describe the diffusive transport of polarization from gas to liquid in the presence of polarization gradients, thermal gradients, and relaxation processes. The technique has the potential for producing polarized liquid ^{3}He nuclear scattering targets with polarizations approaching 10%. (auth)

31758 FERMI-LIQUID TRANSPORT COEFFICIENTS OF DILUTE SOLUTIONS OF ^{3}He IN ^{4}He. Baym, Gordon (Univ. of Illinois, Urbana); Ebner, C. Phys. Rev., 170: 346-50(June 5, 1968).

A slightly modified form of the effective interaction between ^{3}He quasiparticles proposed by Bardeen, Baym, and Pines, used with variational solutions of the transport equation, yields results in satisfactory agreement with recent measurements of the spin diffusion and thermal-conductivity coefficients of two dilute solutions of ^{3}He in ^{4}He at very low temperatures. (auth)

31759 MEASUREMENT OF $(\partial P/\partial T)_v$ AND RELATED PROPERTIES IN SOLIDIFIED GASES. I. SOLID ^{4}He. Jarvis, John F.; Ramm, Dietolf; Meyer, Horst (Duke Univ., Durham, N. C.). Phys. Rev., 170: 320-7(June 5, 1968).

A very sensitive strain gage that is able to detect pressure changes of 2×10^{-5} bar inside a small container filled with solidified helium is described. Measurements of the variation of pressure with temperature along several isochores, both in the hcp and in the bcc phase of ^{4}He, are reported. From these data, the equation of state at $T = 0$°K is obtained, leading to the compressibility coefficient k_T and the change in internal energy as a function of volume. The temperature variation of k_T is then obtained at several molar volumes and compared with results from other experiments. The quantity $(\partial P/\partial T)_v$ is tabulated and its temperature variation is discussed. Combination of $(\partial P/\partial T)_v$ data with those of others for the specific heat gives values of the Grüneisen coefficient, which is shown to be volume- and temperature-dependent. (auth)

31760 IRREVERSIBLE OSMOTIC EXPANSION IN ISOTOPIC SOLUTIONS OF HELIUM. Varoquaux, Eric (CNRS, Orsay, France). Compt. Rend., Ser. A and B, 266: 456-8(Feb. 19, 1968). (In French).

The thermal effects of an irreversible osmotic expansion in diluted solutions of ^{3}He in ^{4}He were calculated for temperatures much below the temperature for the degeneration of ^{3}He in solution. This phenomenon places a lower limit on the temperatures accessible with the aid of a continuous dissolution refrigerator. This lower limit is evaluated to be of the order of a hundredth of a degree absolute. (tr-auth)

31761 PLOTS OF CRITICAL FIELDS OF THE SUPERCONDUCTING MODIFICATION Sn II AT PRESSURES UP TO 270 kbar AND TEMPERATURES 0.1 TO 4.2°K. Brandt, N. B.; Berman, I. V. (Moscow State Univ.). JETP Lett. (USSR) (Engl. Transl.), 7: 152-4(Mar. 1968).

Translated from Zh. Eksp. Teor. Fiz., Piz'ma Redaktsiyu, 7: 198-201(Mar. 20, 1968).

Plots of the critical fields for superconducting Sn II at 240 and 270 kbar indicate that Sn II is a superconductor of type I. The critical fields at 270 kbar are close to the critical fields of ordinary tin at zero pressure and to the fields of Bi II at 26 kbar. The curves reveal a noticeable negative deviation from parabolicity. (A.G.W.)

31762 SUPERCONDUCTIVITY. Rickayzen, G. (Univ. of Kent, Canterbury, Eng.). pp 1-16 of Symposia on Theoretical Physics and Mathematics. 7. Ramakrishnan, Alladi (ed.). New York, Plenum Press, 1968.

The present understanding of the phenomenon of superconductivity is reviewed. Topics included are: macroscopic analysis, formalities, the microscopic condition for the equivalence of the Meissner effect and superconductivity, and special cases. (M.H.R.)

31763 STEP STRUCTURE IN THE RESISTIVE TRANSITION OF A TYPE-II SUPERCONDUCTING ALLOY. Cape, J. A.; Silvera, I. F. (North American Rockwell Corp., Thousand Oaks, Calif.). Phys. Lett., 27A: 13-14(May 20, 1968).

For dc currents greater than a threshold value, the resistive superconducting-to-normal transition proceeds in several well-defined steps. (auth)

31764 DILUTE SOLUTIONS OF ^{3}He IN ^{4}He AT LOW TEMPERATURES. Wheatley, John C. (Univ. of California, San Diego, La Jolla). Amer. J. Phys., 36: 181-210(Mar. 1968).

Properties of dilute solutions of ^{3}He in ^{4}He at low temperatures and their application to dilution refrigeration are discussed from a review–tutorial point of view. A comprehensive review of the properties of dilute solutions is not given. Rather, the simple physical notions underlying an understanding of their properties are discussed. Special emphasis is placed on those phenomena which are of importance in understanding the dilution refrigerator. After a review of the phase-separation phenomenon in ^{3}He–^{4}He solutions, the experimental and theoretical basis for the effective interaction between ^{3}He quasi particles is discussed. Then the energy of the ^{3}He quasiparticles, their chemical potential, and their dependence on the local density and velocity of the superfluid are treated. A few brief remarks on a possible superfluid transition are made. A discussion is given of the qualitative aspects of different types of dilution refrigerators: the "evaporation"-like continuous and single-cycle refrigerators and the "adiabatic expansion"-like superleak operated dilution refrigerator. Then a thermodynamic treatment of these refrigerators is given. Finally some numerical and graphical information, based on the actual properties of ^{3}He and dilute solutions, is given to illustrate the possibilities and problems of the methods. (auth)

31765 DYNAMIC THERMAL EFFECTS IN INTERMEDIATE STATE SUPERCONDUCTORS. Shikina, N. I.; Shikin, V. B. (Physical-Technical Inst. of Low Temperatures, Kharkov. Physical-Technical Inst. of Low Temperatures, Kiev). Zh. Eksp. Teor. Fiz., 54: 1114-19(Apr. 1968). (In Russian).

Thermal effects linear with respect to current produced in a superconductor in the intermediate state by passing a current through it perpendicular to the lamellae are discussed. An expression is derived for the rate of movement of the superconducting regions due to these thermal effects. (auth)

31766 INVESTIGATION OF THE SUPERCONDUCTING PROPERTIES OF ALLOYS WITH A NIOBIUM BASE. Lazarev, B. G.; Ovcharenko, O. N.; Matsakova, A. A.; Volotskaya, V. G. (Physical-Technical Inst. of Low Temperatures, Kharkov). Zh. Eksp. Teor. Fiz., 54: 1031-6(Apr. 1968). (In Russian).

The superconducting characteristics (T_c, H_{c2}) of ternary niobium-zirconium-titanium alloys and binary niobium-titanium alloys are measured for the same samples on which x-ray structural investigations were performed. Some further conclusions concerning the practically important ternary alloys as two-phase systems can be drawn on the basis of the variation of the superconducting transition temperature T_c after annealing of the alloys. A concentration range (in the middle of the concentration triangle) exists for these ternary alloys such that the magnitude of the critical magnetic field $H_{c2} \sim 80,000$ Oe does not change significantly at 4.2°K. (auth)

31767 SECOND VIRIAL COEFFICIENT OF ^{4}He IN THE TEMPERATURE RANGE FROM 2 TO 20°K. Boyd, Marjorie E.; Larsen, Sigurd Y.; Plumb, Harmon (National Bureau of Standards, Washington, D. C.). J. Res. Nat. Bur. Stand., A, 72: 155-6(Mar.-Apr. 1968).

Preliminary values are presented for the second virial coefficient of ^{4}He in the temperature range from 2 to 20°K. They were derived from recent sound velocity measurements in the gas made by Plumb and Cataland using an ultrasonic interferometer. (auth)

31768 CRITICAL VELOCITIES IN He II. Geilikman, B. T. (Physical-Technical Inst., Moscow). JETP Lett. (USSR) (Engl. Transl.), 7: 102-5(Feb. 20, 1968).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 7: 134-6(Feb. 20, 1968).

The behavior of He II at velocities higher than critical, i.e., at velocities corresponding to complete dragging of the He II by the vessel wall, is discussed. The relation of vortex filaments and excitations to the densities of the normal and superfluid components is considered. The errors that result from neglecting the energy of the normal component in the vortex cores when calculating the critical velocity are pointed out. (A.G.W.)

31769 EVIDENCE FOR A DEPENDENCE ON CRYSTALINE ORIENTATION OF THE SUPERCONDUCTING PROPERTIES OF NIOBIUM IN THE MIXED STATE. Gough, C. E. (Univ. of Birmingham, Eng.). Solid State Commun., 6: 215-17(Apr. 1968).

Experimental evidence is presented to show that in single crystals of pure niobium the magnitide of H_{c2}, the slope of the magnetization curve, and the attenuation of sound near H_{c2} all depend markedly on crystal orientation. (auth)

31770 MICROSCOPIC CALCULATION OF THE JOSEPHSON DIRECT CURRENT. Svidzinsky, A. V.; Slusarev, V. A. (Physics-Technical Low Temperature Inst., Kharkov). Phys. Lett., 27A: 22-3(May 20, 1968).

A new microscopic evaluation is given of the Josephson current. (auth)

31771 DERIVATION OF BOLTZMANN-TYPE KINETIC EQUATION FOR AN IMPURE ANISOTROPIC SUPERCONDUCTOR. Yeh, Robert H. T. (Univ. of Illinois, Urbana). Ann. Phys. (N. Y.), 47: 65-78(1968).

Khalatnikov's kinetic equation for an anisotropic superconductor is derived via a Green's function technique, for a case in which the electrons in a weak-coupling anisotropic superconductor are scattered by nonmagnetic impurities. This derivation is valid in the weak-impurity limit ($\Delta \gg \Gamma$), and when external perturbations are slowly varying in space–time. (auth)

31772 LOW-TEMPERATURE EXPANSION OF THE TRANSPORT COEFFICIENTS AND SPECIFIC HEAT OF FERMI LIQUIDS. Emery, V. J. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 170: 205-12(June 5, 1968). (BNL-12124).

The low-temperature expansion of the properties of Fermi liquids is discussed within the framework of Landau's theory. It is shown that the leading corrections to the low-temperature asymptotic forms come mainly from the scattering of quasi particles with small energy and momentum transfer, and that they are proportional to T^3 for the inverse mean free times for thermal conductivity and spin diffusion, and to $T^3 \ln T$ for the specific heat. The energy and damping of a quasi particle are calculated from the same point of view. The special case of a nearly ferromagnetic Fermi liquid is considered explicitly, and comparison is made with results already obtained from a Green's-function approach, from the random-phase approximation, and from the concept of "paramagnons." (auth)

31773 PRESSURE–DENSITY–TEMPERATURE SURFACE OF ^{4}He NEAR THE CRITICAL POINT. Roach, Pat R. (Univ. of Chicago). Phys. Rev., 170: 213-23(June 5, 1968).

The density ρ of ^{4}He as a function of temperature and pressure has been measured along several different paths in the vicinity of the critical point. The results of the measurements are interpreted in terms of power-law descriptions near the critical point: For the coexistence curve, $|\rho - \rho_c| \propto (T_c - T)^{\beta}$; for the critical isotherm, $|P - P_c| \propto |\rho - \rho_c|^{\delta}$; for the critical isobar, $|T - T_c| \propto |\rho - \rho_c|^{\pi}$; for the isothermal compressibility along the coexistence curve, $(1/\rho)(\partial\rho/\partial P)_T \propto |T - T_c|^{-\gamma'_T}$; and for the thermal expansion coefficient along the coexistence curve, $(1/\rho)(\partial\rho/\partial T)_P \propto |P - P_c|^{-\gamma'_P}$ The subscript c identifies the value of a quantity at the critical point. It is shown why simple power-law descriptions might be inadequate to describe all the behavior at the critical point and how this problem can be partly solved by the use of additional, nonsingular factors. The values of the exponents are found to be $\beta = 0.354 \pm 0.010$, $3.8 \leq \delta \leq 4.1$, $3.8 \leq \pi \leq 4.2$, $\gamma'_T = 1.1 \pm 0.1$, and $\gamma'_P = 1.5 \pm 0.2$. Combined with Moldover's specific-heat measurements, which give for the exponent α' of the expression $Cv \propto |T - T_c|^{-\alpha'}$ a value of $\alpha' = 0.017 \pm 0.008$, we can test various inequalities proposed for the exponents. For Rushbrooke's and Fisher's inequality, $\gamma'_T + 2\beta + \alpha' \geq 2$, we obtain 2.0 for the maximum value of the left side; for Griffiths's inequality, $\gamma'_T(\delta + 1)/(\delta - 1) + \alpha' \geq 2$, we obtain 2.2 for the maximum value of the left side; but for Griffiths's inequality, $\beta(\delta + 1) + \alpha' \geq 2$, we obtain only 1.9 for the maximum value of the left side. Possible reasons for this discrepancy are discussed. (auth)

31774 VELOCITY AND ATTENUATION OF FIRST SOUND NEAR THE λ POINT OF HELIUM. Barmatz, M.; Rudnick, I. (Univ. of California, Los Angeles). Phys. Rev., 170: 224-38 (June 5, 1968).

The velocity and attenuation of first sound have been measured to within microdegrees of the λ transition of liquid helium at a frequency of 22 kc/sec. Relative sound-velocity measurements of 1 part in 10^5 could be obtained. The attenuation reaches a maximum about 1 or 2 μdeg below the transition while the velocity minimum occurs 6 μdeg below T_λ. Above the transition, the sound velocity satisfies the necessary condition for the validity of the Pippard–Buckingham–Fairbank relations out to at least 6 mdeg from the λ point. Below T_λ, the velocity shows an added temperature dependence beyond that expected from the Pippard–Buckingham–Fairbank relations, which is proportional to $|T_\lambda - T|^{0.9}$. If this temperature dependence persists, the velocity of sound above and below the transition approaches a common value of 217.3 m/sec at the λ point. Except in the immediate neighborhood of T_λ, the attenuation below the transition is proportional to $|T_\lambda - T|^{-1}$. This result is in agreement with the prediction of the Landau–Khalatnikov theory. Except in the immediate neighborhood of T_λ, the attenuation above the transition is proportional to $|T_\lambda - T|^{-\frac{1}{3}}$. This temperature dependence is not understood theoretically at present. Velocity dispersion results above and below the λ point are also presented. (auth)

31775 VIBRATIONS OF AN ELECTRON BUBBLE IN LIQUID HELIUM. Gross, E. P.; Tung-Li, H. (Brandeis Univ., Waltham, Mass.). Phys. Rev., 170: 190-3(June 5, 1968).

An estimate is made of the frequencies of oscillation of compressional and surface modes of an electron bubble in liquid helium. The liquid is treated as an incompressible fluid with a surface tension determined by the equilibrium bubble radius. There are deviations from Rayleigh's classical formula arising from the quantum potential energy of deformation of an electron in a deformed cavity. These contributions are included in the calculation and a modified formula is obtained. (auth)

31776 PHASE DIAGRAM OF ^{4}He BELOW 1.2°K. Hoffer, J. K.; Waterfield, C. G.; Gardner, W. R.; Phillips, N. E. (Univ. of California, Berkeley). Phys. Lett., 27A: 29-30(May 20, 1968).

The entropies of solid ^{4}He, liquid ^{4}He, and their two-phase mixtures, obtained from constant-volume heat capacity measurements, were used to construct the low-temperature phase diagrams. (auth)

31777 THEORY OF VELOCITY DISTRIBUTIONS OF ATOMS EVAPORATING FROM LIQUID HELIUM II. Gadzuk, J. W. (Massachusetts Inst. of Tech., Cambridge). Phys. Lett., 27A: 23-4(May 20, 1968).

Anomalous temperature dependences found in the velocity distribution of evaporating He II atoms by Johnston and King are explained in terms of current fluctuations and effective helium masses. (auth)

31778 NUCLEAR MAGNETIC RESONANCE IN TYPE-II SUPERCONDUCTORS. pp 320-34 of Magnetic Resonance and Relaxation. Blinc, R. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From International Conference on Magnetic Resonance and Relaxation, 14th Colloque AMPERE, Ljubljana, Yugoslavia. See CONF-660924.

In a certain range of fields, type-II superconductors do not show a complete Meissner effect; the field penetrates in the form of vortex lines, more or less regularly spaced. The main effects of the vortex structure on nuclear resonance properties are the following: (a) The field distribution is not uniform. The line is inhomogeneously broadened, the width ΔH being a decreasing function of the applied field. The theoretical line shape is asymmetric and, as first shown by Matricon, has a logarithmic singularity related to the existence of a saddle point in the field map. The position of this singularity gives rather good information on the nature of the vortex lattice: the triangular lattice is definitely favored by the existing experiments on Nb, V, etc. (b) Spin–lattice relaxation is also inhomogeneous: nuclei close to the vortex cores relax rapidly, with $1/T_1 \sim T$ while nuclei far from the vortex cores essentially see a superconductor at rest (at not too high fields) and have an exponentially slow relaxation at low temperatures. Detailed calculations of $1/T_1$ have been performed by Caroli in the low-field limit for pure superconductors, and by Cyrot in the high-field limit for both pure and dirty superconductors. In the latter case, there is an interesting and simple relation between the relaxation frequency and the position of the spin packet in the resonance line. (c) The spin–spin relaxation may be modified by the existence of inhomogeneous broadening, as suggested by Weger. (d) Some interesting effects may be expected if the vortex lattice is displaced in a controlled way during the experiment. (auth)

31779 RECENT MAGNETIC RESONANCE WORK IN SUPERCONDUCTORS. Knight, W. D. (Univ. of California, Berkeley). pp 311-19 of Magnetic Resonance and Relaxation. Blinc, R. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From International Conference on Magnetic Resonance and Relaxation, 14th Colloque AMPERE, Ljubljana, Yugoslavia. See CONF-660924.

The recent work on NMR in superconductors is reviewed with particular emphasis on the effects of particle size on the NMR width and shift. Pure tin has been investigated for platelet particles ranging in diameter from 100 to 400 Å. The NMR shift, extrapolated to T = 0, varies from 0.8 to 0.6 over this range of particle sizes. Extrapolating to larger particles, it seems likely that the residual shift at T = 0 can easily be as low as 0.5 of the normal value. The residual shift may be attributable to orbital paramagnetism. The results would then be consistent with the mechanism of spin–orbit scattering at the boundaries of the particles which reduces the spin paramagnetism ratio by a factor of the order of $1 - l/\xi_0$, where l is a length of several particle diameters, and ξ_0 is the coherence length. Results are also available for 200 Å particles of lead, in which the residual shift is 0.85. This result is consistent with the above picture, considering the size of the spin–orbit coupling in lead. Recent measurements of NMR relaxation in superconductors are reviewed. (auth)

31780 NUCLEAR SPIN–LATTICE RELAXATION IN TYPE-II SUPERCONDUCTORS. Asayama, Kunisuke (Osaka Univ.); Masuda, Yoshika. pp 439-47 of Magnetic Resonance and Relaxation. Blinc, R. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From International Conference on Magnetic Resonance and Relaxation, 14th Colloque AMPERE, Ljubljana, Yugoslavia. See CONF-660924.

The measurements of the nuclear spin–lattice relaxation time T_1 serve to clarify the physical properties of the type-II superconductors in the mixed state. T_1's of ^{51}V in V–30 at. % Ti and V–40 at. % Ti and ^{93}Nb in Nb–20 at. % Zr alloys were measured as a function of temperature in the range of 4.2 to 1.4°K. The measurements were done by a pulse method in the mixed state $H_{c1} \ll H \ll H_{c2}$ for the Abrikosov state, where H_{c1} and H_{c2} are the lower and upper critical fields, respectively. (M.O.W.)

Plasma and Thermonuclear Physics

Refer also to abstract 32653.

31781 PLASMA PHYSICS. Nagchaudhuri, B. D. (Saha Inst. of Nuclear Physics, Calcutta). pp 1-6 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

A brief review of plasma research areas being carried out at the Institute is given. (M.O.W.)

31782 THE PRODUCTION OF PULSED MEGAGAUSS FIELDS BY COMPRESSION OF THE METALLIC CYLINDER IN Z-PINCH CONFIGURATION. Alikhanov, S. G.; Belan, V. G.; Ivanchenko, A. I.; Karasjuk, V. N.; Kichigan, G. N. (Inst. of Nuclear Physics, Novosibirsk, USSR). J. Phys., E, 1: 543- (May 1968).

The experimental apparatus is described and the experimental results are given for the production of high magnetic fields, up to 3 MG, by flux compression with metallic shell accelerated in Z-pinch configuration. The experimental data are compared with computer calculations. (auth) (UK)

31783 PRODUCTION OF INTENSE SHORT DURATION ION CURRENT. Alikhanov, S. G.; Matochkin, E. P.; Mirzayan, A. S.; Podminogin, A. A. (Novosibirsk Inst. of Nuclear Physics, USSR). Prib. Tekh. Eksp., No. 6, 20-2(Nov.-Dec. 1967). (In Russian).

An efficient method is described for acceleration of plasmoid, ejected from an electrostatic source. The plasmoid characteristics were current I = 80A, current density of $3A/cm^2$, duration, 10^{-6} sec, and energy 100 keV. (R.V.J.)

31784 (AED-C–03-18) PLASMA PHYSICS INDEX. EXPERIMENTAL AND THEORETICAL PLASMA PHYSICS. Bibliography; Author Index; Subject Index. Volume 3, No. 3. Hilsenbeck, D. (comp.) (Zentralstelle fuer Atomkernenergie-Dokumentation, Frankfurt am Main (West Germany)). 1968. 173p. Dep.

A listing is presented of 435 articles on various aspects of plasma physics. Complete subject and author indexes are included. (M.O.W.)

31785 (ORNL–4238) THERMONUCLEAR DIVISION SEMIANNUAL PROGRESS REPORT FOR PERIOD ENDING OCTOBER 31, 1967. (Oak Ridge National Lab., Tenn.). May 1968. Contract W-7405-eng-26. 161p. Dep. CFSTI.

Separate abstracts were prepared for eight individual sections. (M.O.W.)

For abstracts of individual sections see: 31597, 31598, 31787, 31788, 31806, and 31866–31868.

Confinement and Heating of Plasma

31786 (IAE–1259) O NEOBKHODIMOSTI UCHETA SIMMETRII VINTOVYKH MAGNITNYKH POLEI. (Necessity of Making an Allowance for the Symmetry of Helical Magnetic Fields). Maksimov, G. P.; Cheremnykh, P. A. (Akademiya Nauk SSSR, Moscow. Institut Atomnoi Energii). 1966. 8p. (In Russian). Dep.

The work draws attention to the need to take into account the symmetry of helical magnetic fields, which may arise in investigating magnetic surfaces with the aid of an electron beam as well as magnetic traps having fields of this type. (JPRS)

31787 (ORNL–4238, pp 59-66) ELECTRON-CYCLOTRON HEATING. (Oak Ridge National Lab., Tenn.).

Microwave heating of plasmas in the INTEREM facility is briefly described. Ion densities as functions of beam current, microwave power, and pressure are discussed. (M.O.W.)

31788 (ORNL–4238, pp 121-47) MAGNETICS AND SUPERCONDUCTIVITY. (Oak Ridge National Lab., Tenn.).

Research progress is reported on each of the following: (1) the new ELMO magnet system, (2) magnetic probe positioner, (3) cast crossovers for water-cooled magnet coils, (4) the cusp coil test for superconducting winding material, (5) rf sputtering technique for producing thin films, and (6) design of the IMP magnet system. (M.O.W.)

31789 CHARGED-PARTICLE CONTAINMENT IN rf-SUPPLEMENTED MAGNETIC MIRROR MACHINES. Watson, C. J. (Merton College, Oxford). Phys. Rev. Lett., 20: 1231-5(May 27, 1968).

The containment of particles is studied in the loss cone of a magnetic-mirror machine by means of rf fields whose frequency slightly exceeds the maximum value of the ion cyclotron frequency within the plasma. Computations are reported which verify the adiabatic theory of this confinement system. (auth)

31790 INVESTIGATION OF THE HIGH TEMPERATURE ELECTRON COMPONENT OF A PLASMA PRODUCED IN THE PLASMA–BEAM SYSTEM. Zakatov, L. P.; Plakhov, A. G.; Ryutov, D. D.; Shapkin, V. V. Zh. Eksp. Teor. Fiz., 54: 1088-98(Apr. 1968). (In Russian).

Results are presented of an investigation of the properties of the hot component of a plasma produced by an intense electron beam in an adiabatic trap with a large mirror ratio. The dependence of the electron temperature and total energy of the plasma on the magnetic field strength, diaphragm radius and heating duration is found. The dependence of the turbulent diffusion coefficient on the magnetic field strength is derived. A model of beam heating is proposed which is based on the assumption that the source of the heated particles is the electron beam. This model satisfactorily agrees with the data of our experiments and also with those of previous experiments. (auth)

31791 RF HEATING OF A CYLINDRICAL PLASMA. Maiti, J. N.; Basu, J. (Saha Inst. of Nuclear Physics, Calcutta). pp 17-23 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.
See CONF-670220–(Vol.2).

The rf heating of a cylindrical plasma by the standard induction and dielectric heating methods is discussed. The plasma is considered either as a conductor with a finite amount of reactance or as a lossy dielectric, and results are given, relating the power absorbed by the plasma to the operating frequency and to the parameters of the plasma, viz., its dimensions, the electron density and electron collision frequency. (auth)

Diagnostics of Plasma

31792 (IPPCZ-53) PRISPEVEK REZONATOROVE METODE MERENI KONCENTRACE ELEKTRONU PLAZMATU. (Use of Resonance Method for Measuring Electron Concentration in Plasma). Bohacek, V. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Apr. 1966. 25p. (In Czech). Dep.

This article discusses the problem of determining the electron density in a plasma in a cylindrical resonant cavity. The determination is based upon the behavior of the resonator in the presence and in the absence of a plasma. Equations (in operator form) are given for four cases (1) the general case where the electron density of the plasma is inhomogeneous and the plasma is bounded by a symmetrical surface of rotation; (2) the plasma is inhomogeneous and the plasma stream has a constant radius; (3) the plasma is homogeneous, but the boundary of the plasma is a general surface of rotation; (4) the plasma is homogeneous and of constant radius. For the last special case, tables and graphs based on calculation with an electronic computer are given for a complete range of the ratio of the radius of plasma to the radius of the cylindrical resonator. (TTT)

31793 (SIT-2813-45) Q-MACHINE PLASMA CAMERA. Destler, William Wallace (Stevens Inst. of Tech., Hoboken, N. J.). 1968. Contract AT(30-1)-2813. 36p. Dep. CFSTI.
Thesis.

A device to determine the spatial distribution of a magnetically confined, quiescent potassium plasma has been constructed following the basic design of Sinel'nikov, et al. Initial results at low plasma number density (10^9 to 10^{10} cm^{-3}) confirm Langmuir probe measurements and add substantially to the knowledge of the instantaneous asymmetry of the plasma at points along the plasma column. Results at higher plasma density are expected to yield better resolution and more information on the relation of asymmetry to plasma instability. (auth)

31794 IONIZATION TIME IN SHOCK-HEATED ARGON BY THE LANGMUIR PROBE TECHNIQUE. Hill, William Watson Jr. Fort Collins, Colo., Colorado State Univ., 1967. 148p.
Thesis.

Experimentation was performed in the CSU three-inch shock tube to determine the behavior of small cylindrical Langmuir probes in the plasma generated by a shock wave. The applicability of the Langmuir probe for ionization relaxation time measurements was investigated. The range of conditions covered in these tests is characterized by: $7 \leq M \leq 9$ and $20\mu \leq p \leq 2$ mm Hg. Test time limitations of the facility restricted effective ionization time information to the Mach number range from 8 to 9 and initial pressures of 1- to 2-mm Hg. Shock conditions were such that the probe was operating in a free molecular flow with respect to the charged particles. The flow bordered on continuum conditions with respect to the neutral atoms. When sufficient time was available, the probe followed the rise of the ionization to equilibrium. Measured relaxation times were in agreement with theoretically predicted values. Equilibrium electron densities predicted by the probe response were just slightly less than the values predicted by the Saha Equation. (Disser. Abstr.)

31795 TRIPLET TO SINGLET EXCITATION OF C V IONS IN HIGH-TEMPERATURE PLASMAS. Prasad, A. N.; El-Menshawy, M. F. (Univ. of Liverpool). J. Phys., B, 1: 471-8(May 1968).

Measurements of the relative intensities of C V 2 $^1S-2$ ^1P (3541 Å), C V 2 $^3S-2$ $^3P_2$ (2271 Å), and C IV 4 $^2D-5$ ^2F (2524.4 Å) lines from relatively low-energy ($\simeq$12.5 kJ) theta-pinch discharges in methane (electron density $\simeq 4 \times 10^{17}$ cm^{-3}, electron temperature $kT_e \simeq 40$ eV) are reported. From these experimental data the total triplet-to-singlet excitation rate coefficient amongst the $n = 2$ levels of the C V ion is estimated to be about 4×10^{-9} cm^3 s^{-1} at $kT_e = 37$ eV with an overall uncertainty of about a factor of 2. This observed value is substantially in agreement with the predicted maximum theoretical value for s-wave electrons. (auth)

31796 EXPERIMENTAL STUDIES OF A COAXIAL PLASMA INJECTOR. II. PROBE MEASUREMENTS OF ELECTRON TEMPERATURE. Sadowski, Marek; Skladnik-Sadowska, Elzbieta (Inst. of Nuclear Research, Swierk, Poland). Nukleonika, 13: 269-78(1968).

In order to determine the conductivity and electron temperature of plasma generated by a coaxial injector, a detailed analysis of diamagnetic signals from plasmoids injected into a uniform magnetic field was performed. For purposes of comparison, a number of measurements were made by means of a double Langmuir probe for the case without the external magnetic field, and in the space beyond the diagnostic field. (auth)

31797 MICROWAVE INVESTIGATION OF THE TRANSITION FROM AMBIPOLAR TO FREE DIFFUSION IN AFTERGLOW PLASMAS. Freiberg, R. J. (Hughes Research Lab., Malibu, Calif.); Weaver, L. A. Phys. Rev., 170: 336-41(June 5, 1968).

The time decay of electron density in pulsed helium afterglow discharges is studied experimentally employing both conventional and modified microwave-cavity techniques. The two methods permit density measurements from $n_e \simeq 10^{11}$ cm^{-3} to as low as $n_e \simeq 2 \times 10^4$ cm^{-3} in helium at pressures of 0.4 and 4.0 torr. For Debye lengths less than ~1% of the characteristic diffusion length Λ, the electron loss rate is through ambipolar diffusion controlled by the atomic ion He^+ at 0.4 torr and by the molecular ion He_2^+ at 4.0 torr. At lower electron densities, the electrons diffuse more rapidly than ambipolar diffusion, and in the limit of Debye lengths much greater than the characteristic diffusion length, the electrons diffuse freely to the walls. The experimentally observed effective diffusion coefficient D_s in the transition region is compared with a mathematical expression proposed by Phelps relating D_s to n_e. Satisfactory agreement is obtained at 4.0 torr where the electron mean free path $\lambda \ll \Lambda$. By using this expression to calculate theoretically expected decays of electron density, a computer optimization procedure produced an even better fit to experimental data by slightly altering a numerical parameter in the formula. At 0.4 torr, where $\lambda \approx \Lambda$ and the theoretical treatment is not expected to be valid, diffusion in the transition region is observed to occur at a rate substantially less than that predicted theoretically. (auth)

31798 AFTERGLOW MEASUREMENTS OF A LASER BREAKDOWN PLASMA. Lampis, G.; Brown, Sanborn C. (Massachusetts Inst. of Tech., Cambridge). Phys. Fluids, 11: 1137-46 (June 1968).

A highly ionized plasma in helium at a pressure of 10 atm was produced by a giant laser pulse. The properties of the plasma were studied by a dc helium–neon gas laser. Measurements of the variation of the shape and size of the plasma, its electron density and temperature, and its absorption coefficient at 6328 Å were made during the afterglow between 100 and 600 nsec. The shock wave emitted by the plasma was also studied. (auth)

31799 SPECTROSCOPIC DIAGNOSTICS OF PULSE PLASMA JETS AT ATMOSPHERIC PRESSURE AND IN VACUUM. Bakanovich, G. I.; Grechikhin, L. I.; Min'ko, L. Ya. Zh. Prikl. Spektrosk., 8: 412-15(Mar. 1968). (In Russian).

The change of the structure of plasma jets of pulse generators with laser ignition was studied as a function of the pressure of the surrounding medium. It was shown that the plasma jets, during operation of the pulse generator in vacuum, consists principally of vapors of the material of the walls of the discharge chamber. Methodical questions of the spectroscopic diagnostics of the plasma jet in vacuum were examined. The concentration of the charged particles in the plasma jet was measured at atmospheric pressure and in vacuum by different methods. (tr-auth)

31800 METODY SKOROSTNYKH IZMERENII V GAZODINAMIKE I FIZIKE PLAZMY. (Methods of Measuring Velocities in Gasdynamics and Plasma Physics). Nesterikhin, Yu. E.; Soloukhin, R. I. Moscow, Izdatel'stvo Nauka, 1967. 172p.

Methods for measuring density, temperature, pressure, concentrations, and magnetic and electric field intensities in shock tubes and plasma injectors are presented. Installations for high-speed ionized gas compression by magnetic field and other pulsed gasdynamic and plasma apparatus are discussed. Methods for developing shock waves, fast gas jets, and high-temperature plasma are analyzed. Methods for observing high-speed gas flow and various means for measurements of density of neutral particles and electrons are described. Spectral methods for measuring temperature and concentrations and a method for transient mass spectroscopy in pulsed plasma devices are outlined. (R.V.J.)

Kinetics of Plasma

31801 (D-1-82-0705) ANOMALOUS SKIN EFFECT IN A GASEOUS PLASMA. Kofoid, Melvin J. (Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.). Jan. 1968. 16p. Dep.

Experimental data are presented for the skin effect in a plasma in which the electron thermal motions are sufficient to increase the field penetration. The results are consistent with the Weibel criteria for the existence of anomalous penetration and with the theoretical anomalous penetration depth. (auth)

31802 (D-1-82-0706) PENETRATION OF A HIGH-FREQUENCY FIELD IN A LOW-PRESSURE PLASMA. Kofoid, M. J.; Cleva, H. V. (Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.). Jan. 1968. 46p. Dep.

Comparisons between calculated and directly measured values of radial penetration of axially directed magnetic fields in cylindrical plasmas have been effected. Using small-amplitude elementary theory, the curve of field intensity vs radius was calculated which matched the measured intensity at the axis. In this calculation the degree of variation of conductivity vs radius was taken as that determined from the measured electron temperature T_e and density n_e. The level of conductivity demanded by theory was then compared with that deduced directly from the measured n_e and T_e. When the experimental conditions corresponded closely to those assumed in the elementary theory development, the plasma conductivity required by theory for a measured field penetration agreed well with that calculated from the measured T_e and n_e. With poorer correspondence, a large disagreement was found. The difficulty underlying the disagreement appears to be in the evaluation of the actual drift velocity. The elementary expressions necessarily ignore the facts that the drift velocity can be increased due to inelastic electron collisions and by runaway electrons. It is believed that these phenomena did increase the conductivity and thereby alter the penetration. The investigation was made in 5-cm-diameter noble gas discharges in a 5 to 500-μ range of pressures with steady 500-kc fields of 50 to 80-G intensity at the plasma surface. Probe measurements provided the electron density n_e and temperature T_e and also the magnetic field strength within the plasma. The plasmas, with $n_e = 10^{11}$ to 10^{14} per cm^3 and $T_e = 2$ to 12 eV, were intense enough to display considerable skin effect. (auth)

31803 (FEI-96) VLIYANIE VOZMUSHCHENII V LENGMYUROVSKOM SLOE U KATODA NA SKOROST IONIZATSII V DUGOVOM RAZRYADE. (Effect of Disturbances in the Langmuir Layer of Cathode on the Ionization Rate in Arc Discharge). Stakhanov, I. P. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1967. 23p. (In Russian). Dep.

The results of several studies of nonequilibrium ionization in low-voltage arcs are summarized. A statement of the problem is presented and formulas of ionization rate in various instances are derived. The number of ions arising in the inter-electrode gap owing to nonequilibrium ionization is estimated, as is the width of the region within which this ionization occurs. (JPRS)

31804 (FEI-106) FUNKTSIYA RASPREDELENIYA BYSTRYKH ELEKTRONOV NA GRANITSE S ELEKTRODOM. (Distribution Function of Fast Electrons at the Boundary With the Electrode). Stakhanov, I. P.; Shcherbinin, P. P. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1967. 16p. (In Russian). Dep.

The kinetic equation is solved for fast electrons and the electron distribution function is investigated in the neighborhood of a nonemitting electrode. The electron flux across the potential barrier (for a given plasma density) and the extrapolated length for electrons are elucidated. (JPRS)

31805 (LA-DC-9540) TRANSMISSION AND EMISSION OF RADIATION BY A MAGNETIZED LABORATORY PLASMA. Dreicer, Harry (Los Alamos Scientific Lab., N. Mex.). [1965]. Contract W-7405-eng-36. 50p. Dep. CFSTI.

Experimental and theoretical comparisons were made for data on the transmission and emission of radiations from magnetoplasma. (M.O.W.)

31806 (ORNL-4238, pp 67-104) PLASMA PHYSICS. (Oak Ridge National Lab., Tenn.).

The following are described: (1) beam-plasma interactions; the hot-electron plasma, (2) studies of neutral light emission from the Burnout plasmas, (3) Burnout V gas analysis, (4) high-pressure arc, (5) further spectroscopic studies of the high-density helium arc, (6) dispersion of ion-acoustic waves, (7) variation of ion-acoustic wave properties with electron temperature, (8) symmetric discharge, (9) ECH in a mirror machine using a simple dipole antenna, and (10) toroidal multipoles. (M.O.W.)

31807 (ORNL-TM-2101) NONLINEAR INTERACTIONS IN QUANTUM PLASMAS. Wilems, R. E.; Ritchie, R. H. (Oak Ridge National Lab., Tenn.). June 1968. Contract W-7405-eng-26. 166p. Dep. CFSTI.

Thesis. Submitted by R. E. Wilems to Univ. of Tennessee, Knoxville.

Interactions of photons and fast electrons with plasmons in both bounded and unbounded systems are investigated within the framework of a quantum hydrodynamic model for the plasma. Plasmons in both perfect plasmas and plasmas containing structural imperfections are studied. Among the several interactions of photons with perfect plasmas which are examined are radiative damping of plasmons, resonance fluorescent scatter, second harmonic generation, and Raman scatter. The frequency shift of the radiative surface plasmon due to coupling with the radiation field is investigated, and resonance emission from photon-stimulated plasmons in imperfect plasmas and "grating" plasmas is also explored. Characteristic energy loss and gain by fast electrons through interaction with the plasmon field are studied. In addition, energy exchange through the plasmon field between various combinations of electrons and photons is examined. The process of "Auger" electron emission from a semi-infinite plasma through the deexcitation of electron-excited surface plasmons is also investigated. (auth)

31808 POSSIBLE EXCITATION OF HIGH-FREQUENCY WAVES BY A LARGE AMPLITUDE LOW-FREQUENCY WAVE IN A PLASMA. Nishikawa, Kyoji; Tanaka, Takayasu (Kyoto Univ.). Progr. Theor. Phys. (Kyoto), 39: 238-9(Jan. 1968).

Two possible mechanisms which lead to the excitation of hf waves by large-amplitude lf waves are discussed. (M.O.W.)

31809 DAMPING OF PLASMA OSCILLATIONS IN WEAK MAGNETIC FIELD. Mazitov, R. K.; Fridman, A. M. (Inst. of Nuclear Physics, Novosibirsk, USSR). pp 169-73 of Problema Mnogikh Tel i Fizika Plazmy. Bonch-Bruevich, V. L. Moscow, Izdatel'stvo Nauka, 1967. (In Russian).

The influence of a magnetic field on damping of longitudinal electron oscillations is investigated. It is shown that in the absence of collisions, a weak magnetic field prevents formation of a "plateau" in the distribution function and leads to the stationary damping of the oscillations. The damping rate is determined by the electron cyclotron frequency. (auth)

31810 PERTURBATION THEORY FOR NONLINEAR OSCILLATIONS IN A COLLISIONLESS PLASMA. Karpman, V. I. (Novosibirsk State Univ., USSR). pp 157-68 of Problema Mnogikh Tel i Fizika Plazmy. Bonch-Bruevich, V. L. Moscow, Izdatel'stvo Nauka, 1967. (In Russian).

The dynamical perturbation theory for nonlinear oscillations in a collisionless plasma is derived. Summation of the series of secular terms leads to the equations for "slow" processes, describing nonlinear wave-particle and wave-wave interactions in a plasma. (auth)

31811 ELECTRICAL CONDUCTANCE OF A TURBULENT PLASMA. Petviashvili, V. I.; Ramazashvili, R. R.; Tsintsadze, N. L. (Inst. of Physics, Tbilisi, USSR). pp 192-8 of Problema Mnogikh Tel i Fizika Plazmy. Bonch-Bruevich, V. L. Moscow, Izdatel'stvo Nauka, 1967. (In Russian).

The electrical conductance of a homogenous, weakly turbulent, magnetoactive plasma was investigated, under the assumption that oscillations are possible. Under certain conditions the electrical conductance of such a plasma can be anomalously small. This phenomenon can be explained by an effective increase in the frequency of ion-electron collisions that are caused by collective particle interactions. Only low-frequency oscillations (in which both electrons and ions participate) give a significant contribution to the turbulent-plasma resistance. A formula was found, using the turbulent oscillation spectrum, for the electrical conductance of the weakly turbulent plasma. Comparison of the conductance with the anomalous diffusion across the magnetic field shows that they both contain the same quantity (determined by the oscillation spectrum), which can be interpreted as an effective collision frequency; hence one draws the conclusion that this effective collision frequency will play the role of ordinary collisions in other macroscopic processes also. The effective collision frequency was evaluated for the Drummond-Rosenbluth instability, and using it, the width of the weak shock wave in collisionless plasma was found. The formula for the effective collision frequency of an isotropic plasma was also found. (auth)

31812 EXPERIMENTAL STUDIES OF A COAXIAL PLASMA INJECTOR. I. STUDY OF OPERATIONAL CONDITIONS. Sadowski, Marek; Skladnik-Sadowska, Elzbieta (Inst. of Nuclear Research, Swierk, Poland). Nukleonika, 13: 257-67(1968).

Investigations were made on the optimization of the parameters and operational conditions of a coaxial plasma injector. A detailed description of the experimental system is given, and the results of measurements performed by means of magnetic probes and a high-speed camera are discussed. The velocities of plasmoids emitted are determined and the regime of efficient operation of the injector is established. (auth)

31813 SELF-TRAPPING AND SELF-FOCUSING OF ELECTROMAGNETIC WAVES IN A PLASMA. Dysthe, K. B. (Univ., Bergen). Phys. Lett., 27A: 59-60(May 20, 1968).

The self-action effects of electromagnetic waves in a plasma are investigated. It is shown that they may be important when the electromagnetic energy density becomes comparable to the thermal energy density of the plasma. (auth)

31814 SOME CHARACTERISTICS OF RADIO FREQUENCY PLASMAS. Jayakumar; Karandikar, D. V.; Aziz, M. A. (Bhabha Atomic Research Centre, Trombay, India). pp 11-16 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

Studies were made on certain characteristics of the radiofrequency H-type plasmas at high and low pressures and E-type plasmas at low pressures. The conditions for the generation of highly conducting nonequilibrium plasma are enumerated. (auth)

31815 MECHANISM OF FIRST-ORDER PHASE TRANSITIONS IN QUANTUM COULOMB PLASMAS. Carmi, G. (Yeshiva Univ., New York). Phys. Lett., 27A: 8-9(May 20, 1968).

The partition function for a quantum Coulomb plasma is calculated in the random-phase approximation. A first-order phase transition is found for an electron plasma at $r_s = 7.6$ and for white dwarfs at $\sim 10^{7}$°K. (auth)

31816 KINETIC-THEORETICAL APPROACH TO THE FLUCTUATIONS IN WEAKLY TURBULENT PLASMAS. Ichimaru, S. (Univ. of Illinois, Urbana). Phys. Lett., 27A: 40-1 (May 20, 1968).

A self-consistent integral equation for the energy spectrum of fluctuations in a weakly turbulent plasma resulting from the onset of a plasma wave instability is derived from a solution of the BBGKY hierarchy in the fluid limit. (auth)

31817 A TENTATIVE EXPLANATION OF THE ANOMALOUS ATTENUATION OF ELECTROMAGNETIC SURFACE WAVES ON PLASMA COLUMNS. Anicin, B. A. (Boris Kidrich Inst. of Nuclear Sciences, Belgrade). Phys. Lett., 27A: 56-7(May 20, 1968).

An explanation of the high attenuation of electromagnetic surface waves on plasma columns which occurs in the region of low phase velocity is based on a perturbation expression for the attenuation coefficient and cold plasma theory. (auth)

31818 RELATION BETWEEN ENHANCED LONGITUDINAL RESISTIVITY AND ENHANCED TRANSVERSE DIFFUSION. Weinstock, Jerome (Environmental Science Services Administration, Boulder, Colo.). Phys. Rev. Lett., 20: 1149-53(May 20, 1968).

Enhanced diffusion in turbulent plasmas across a magnetic field is accompanied by an anomalous decrease in electric conductivity parallel to the field. By relating the Kubo–Green formula to Spitzer's diffusion formula, a general relationship between anomalous longitudinal resistivity and anomalous transverse diffusion is derived for electrostatic and transverse turbulences. The results account for the great enhancements in parallel resistivity which are observed for both weak and strong turbulence. (D.L.C.)

31819 RADIATION FROM A CHARGED PARTICLE MOVING IN A PLASMA. Ray, Tushar (Univ. Coll. of Science, Calcutta). Proc. Nat. Inst. Sci. India, Part A, 33: 133-41(July 1967).

Interaction of a beam of charged particles with a plasma has been studied, taking into consideration the effect of beam temperature and assuming progressive wave solution. The frequency and amplitude of the first few harmonics have been obtained for beam velocity $\bar{v} > v_\phi$ and $v_\phi \ll c$. The spectrum of radiation from a single charged particle moving in the progressive wave field excited by the beam has also been derived and some numerical results are given. (auth)

31820 KINETIC THEORY OF A WEAKLY TURBULENT PLASMA. I. INTERACTION HAMILTONIAN OF ELEMENTARY PROCESSES. Kurasawa, Takasi; Matsuura, Kenya (Electrotechnical Lab., Tokyo). Denki Shikensho Iho, 31: 1269-93(1967).

A collective description of a plasma consisting of ions and electrons is investigated. The investigation is made by an extension of the Bohm–Pines collective description of the electron plasma to a plasma in which ions also behave collectively. The Hamiltonians for linear interaction of ion waves, three-wave interaction among electron waves and an ion wave, and particle–wave–wave interactions are obtained as the basis of the discussion of the nonlinear kinetics of a weakly turbulent plasma. As the particle–wave–wave interactions, the interactions of the electron–ion wave–ion wave, ion–ion wave–ion wave, ion–electron wave–electron wave, and electron–electron wave–ion wave are considered. (auth)

31821 RADIATION TRANSPORT IN ATOMIC PLASMAS. Wilson, K. H. (Lockheed Research Lab., Palo Alto, Calif.); Greif, R. J. Quant. Spectrosc. Radiative Transfer, 8: 1061-86 (Apr. 1968).

A general study of radiation transport in a nonuniform plasma was made, including line and continuum processes. Available atomic absorption coefficient data from nonhydrogenic calculations and experiments for high-temperature air are discussed. General relations are derived for the intensity, flux, and flux divergence. Under uniform conditions, detailed transport comparisons are made with other theoretical predictions and recent experimental data. Results are also presented for the power radiated from air for temperatures between 10^4 and 2×10^4°K, pressures between 10^{-1} and 10^2 atm, and plasma thicknesses between 1 and 30 cm. In addition, the flux was obtained for a representative nonuniform shock layer condition and compared with the results from a uniform calculation. (auth)

31822 CONDITIONS FOR THE EXISTENCE AND MAINTENANCE OF A POPULATION OF FAST ELECTRONS IN HIGH-FREQUENCY DISCHARGES WITH CAPACITIVE COUPLING AND EXTERNAL ELECTRODES. Vacquie, Serge; Bacri, Jean; Serrot, Gerard (Faculte des Sciences, Toulouse). Compt. Rend., Ser. A and B, 266: 387-90(Feb. 12, 1968). (In French).

The existence of fast electrons in an electrodeless high-frequency plasma was shown experimentally. A simple model is proposed that permits the explanation of their existence and maintenance. (tr-auth)

31823 EFFECT OF STRONG COLLISIONS ON THE H_α PROFILE. Bacon, Michael E.; Edwards, David F. (Colorado State Univ., Fort Collins). Phys. Rev., 170: 125-7(June 5, 1968).

Strong collision effects are appreciable for the H_α spectral line. Including these effects in H_α profile calculations, one finds agreement between experiment and theory within experimental error. (auth)

31824 POPULATION OF EXCITED LEVELS OF ATOMS AND IONS: ELECTRON TEMPERATURE AND DENSITY FROM RELATIVE LINE INTENSITIES OF THE IONS C IV, N V, AND O VI. Suckewer, S. (Inst. of Nuclear Research, Warsaw). Phys. Rev., 170: 239-44(June 5, 1968).

The theory of the population of excited levels for atoms and ions is given for stationary, nonthermal plasmas. Simplified expressions were obtained, with the aid of which populations of the levels 2P, 3P, and 3D were determined for the ions C IV, N V, and O VI. It is shown that the populations obtained by this method are in very good agreement with the populations determined directly from the balance of excitation and de-excitation processes. Plots are given which enable the determination of electron density and temperature from relative intensities of three chosen lines from a given ion. (auth)

31825 SOME NEW RESULTS CONCERNING THE RADIATION PRESSURE ON THE PLASMA–VACUUM BOUNDARY. Klima, R.; Petrzilka, V. A. (Inst. of Plasma Physics, Prague). Phys. Lett., 27A: 20-21(May 20, 1968).

The tensor of time averaged stresses arising in a magnetoactive plasma under the effect of an oscillating electromagnetic field is derived. It is proved that the radiation pressure need not arise on the plasma–vacuum boundary even if the electromagnetic wave falling from vacuum is reflected substantially. (auth)

31826 THEORETICAL STUDIES OF CONTINUUM, WEAKLY IONIZED GAS FLOWS INCLUDING COMPRESSIBILITY AND ELECTRON ENERGY EFFECTS. Burke, Andrew Francis. Princeton, N. J.; Princeton Univ., 1967. 169p.

Thesis.

A general theory for the flow of weakly ionized gases about electrically biased bodies in continuum flow is presented. Particular attention is given to the derivation of mass and energy transport and energy exchange relations for the ionized species which are applicable in a two-temperature plasma, delineation of the various regions (sheath, viscous ambipolar, electron thermal, external field fringing) by which the flow field can be described, and the role and consequences of various electron energy transfer and exchange processes. Numerical results for the electric field and electron temperature distributions and current–voltage characteristics for simple body shapes are given for a range of Mach number, Reynolds number, surface-temperature (T_w/T_0), and values of the energy-transfer and exchange parameters. Methods of correlating the results are presented which facilitate their application and interpretation in cases other than those calculated. (Disser. Abstr.)

31827 AFTERGLOW STUDIES IN NITROGEN. Lund, Roger Edward. Minneapolis, Univ. of Minnesota, 1967. 192p.
Thesis.

The present study is concerned with the temporal behavior of the N^+, N_2^+, N_3^+, and N_4^+ ions in nitrogen as well as with that of the afterglow light intensity in the pressure range of about 0.1 to 1.7 torr. The effect of different pulse lengths was also investigated. The nitrogen afterglow studies presented were performed through the use of the time-sampling technique applied to light intensity and ion density measuring apparatus. The afterglow was produced by periodic rf pulses in a glass tube coated with a molybdenum film. An electric quadrupole mass spectrometer was used for ion mass identification while a light spectrometer allowed a determination of the spectral distribution. The analysis of the light intensity decay curves revealed that nitrogen atoms are not always destroyed upon collision with the wall. An equation describing the surface catalytic efficiency γ_N for the destruction (or recombination) of nitrogen atoms at the plasma boundary was developed and applied to the data. The value of γ_N was found to decrease with pressure from a value of 0.22 at 0.09 torr to 0.04 at 1.35 torr. This behavior shows that the value of γ_N is governed by the adsorption of molecular nitrogen over a monolayer of atomic nitrogen bound to the wall. It was found from an analysis of the N_2^+ ion density decay curves at low pressures that the surface catalytic efficiency γ_x for the destruction of a certain metastable N_2^x molecule was much smaller (of the order of or smaller than 10^{-3}). The light intensity and N_2^+ ion density decay curves also yielded evidence that the interaction of certain metastable N_2^x molecules, formed via the volume atomic recombination process, produce N_2^+ ions and light emission. The afterglow ionization results in the liberation of energetic electrons and a corresponding increase in the electron temperature. The value of the electron temperature, determined through consideration of the losses of the N^+ ion density, varied from 1600 to 4500°K in the pressure range 0.27 to 1.72 torr. The metastable N_2^x molecule was identified from energy and radiative lifetime considerations as the $a'\ {}^1\Sigma_u^-$ molecule. A cross section of 1.3×10^{-18} cm^2 was found for the destruction of metastable $a'\ {}^1\Sigma_u^-$ molecules by collisions with ground state molecules, provided both interacting metastable molecules are in the $a'\ {}^1\Sigma_u^-$ state. It is possible that one of the colliding particles is a metastable molecule in the $A\ {}^3\Sigma_u^+\ {}^3\Delta_u$ state. The temporal behavior of the N_2^+ ion density at a pressure of 0.54 torr allowed an estimate of the cross section $\sigma = 4.6 \times 10^{-18}$ cm^2. Evidence was obtained for an afterglow electron heating mechanism involving electrons and vibrationally excited ground-state molecules. (TSS) (Disser. Abstr.)

31828 CROSS-FIELD DIFFUSION OF QUIESCENT POTASSIUM MAGNETOPLASMAS. Wolf, Neil Stephen. Hoboken, N. J., Stevens Inst. of Tech., 1967. 92p.
Thesis.

Measurements of the diffusion coefficient of a highly ionized, isothermal plasma across a confining magnetic field have been made with a new type of probe in a plasma generated by surface ionization of potassium vapor. The probe consists of a grid (which serves as one endplate of the plasma column) behind which is located a planar ion-collecting electrode. This probe structure is moved along the axis of the plasma column and the current collected by the electrode as a function of grid-probe to ionizing surface distance is related to the perpendicular diffusion coefficient. The results, for operation in a quiescent mode, show good quantitative agreement with the diffusion coefficient derived for binary electron – ion collisions in a fully ionized plasma. (Disser. Abstr.)

31829 SECULAR EFFECTS AS RELATED TO THE NONLINEAR BEHAVIOR OF PLASMAS. McIntosh, Robert Edward Jr. Iowa City, Univ. of Iowa, 1967. 91p.
Thesis.

This treatment includes the nonlinear behavior which results when the plasma is in the presence of a strong external time varying electromagnetic field. Certain nonlinear phenomena are predicted when a modified form of Duffing's equation is used to model the longitudinal electric field in a plasma. By using a multiple time-scale perturbation method, harmonic and subharmonic oscillations and frequency shifts are calculated which agree well with experiment. Five experiments are described. The first experiment describes second harmonic generation when an electric field impinges on a mercury vapor discharge plasma column placed in a waveguide such that both the electric field vector and the direction of propagation are perpendicular to the axis of the column. Experiment II treats the case where the electric field is parallel to the axis of the column. In experiment III the second harmonic power was measured when the direction between the electric field and the axis of the column was varied. The power incident on the plasma column was increased to about 1 watt in experiment IV. Second and third harmonics were generated for this case which had frequency shifts that agreed with theory. Finally, a one-half subharmonic was excited in experiment V by using a special dipolar excitation structure. (Disser. Abstr.)

31830 DISPERSION AND ABSORPTION OF ELECTROMAGNETIC MODES IN A MAGNETO QUANTUM PLASMA. Beaudet, Paul Roger. Providence, Brown Univ., 1967. 169p.
Thesis.

A quantum derivation that takes full account of the diffusion current is given for the magnetoconductivity tensor of an electron gas in the presence of impurities. The dispersion relations for self-sustained electromagnetic modes of a one and two-component plasma propagating at arbitrary angles to the applied magnetic field are obtained. Particular attention is paid to the interaction of the helicon and longitudinal plasma modes. The attenuation of these modes via collision damping, Landau damping, and Doppler-shifted cyclotron resonance damping is derived with emphasis placed on the structure of the giant quantum peaks in the Landau damping of the helicon mode and on the collision broadening of these peaks. (Disser. Abstr.)

31831 MOTION OF AN ELECTRIC ARC IN THE TRANSVERSE MAGNETIC FIELD. Hingst, Warren Robert. Madison, Wis., Univ. of Wisconsin, 1967. 142p.
Thesis.

Experiments were conducted to evaluate the interaction of an electric arc with a transverse magnetic field. The experimental apparatus consisted of circular ring shaped electrodes with an externally applied radial magnetic field. All experiments were conducted in an argon atmosphere. The interaction of the electric arc with the transverse magnetic field produces a Lorentz force acting in the azimuthal direction; this force drives the arc along the circular electrodes. This electrode – magnetic field arrangement allows continuous operation of the arc experiment. The repeated passage of the arc over the electrodes ensures a rapid approach to stabilized and uniform electrode surface conditions which are known to have an important bearing on moving arc behavior. Arc velocity and arc voltage measurements are presented for a range of values of arc current from 160 to 320 A, magnetic fields from 109 to 545 G, gas pressures from 100 to 700 mm Hg and electrode spacings from 1.5 to 10.0 mm. The arc velocity is found to vary with magnetic field to the 0.575 power, with arc current to the 0.365 power, and gas pressure to the –0.39 power. The arc electric field is found to vary with arc velocity to the 1.20 power. High speed motion pictures and short exposure time still photographs show the arc motion to be uniform with the arc slanting from the anode toward the cathode in the direction of motion. The angle of the arc to the electrode normal is about 45°. The data of the arc motion experiment are compared with other arc experiments as well as theoretical models presented in the literature. The differences between moving and stationary arcs are discussed with emphasis on the influence of electrode surface phenomena. (Disser. Abstr.)

31832 ELECTRICAL AND THERMAL CONDUCTIVITIES OF A FULLY IONIZED GAS. Fricke, Clifford Lynn. Blacksburg, Va., Virginia Polytechnic Inst., 1967. 68p.
Thesis.

Thermal and electrical conductivities based on the Balescu equation were calculated, taking into account both electron–electron and electron–proton interactions, but neglecting the small effects due to the motion of the protons. Starting with the Balescu kinetic equation, linearization is obtained by assuming that either a small electric field or a small temperature gradient exists in the plasma. The Chapman– Enskog perturbation method, along with the steady-state hydrodynamic approximation that a local equilibrium is set up with spatial variations existing only in number density and temperature, is used to obtain the first-order equation in the unknown electron distribution function. This equation is reduced to an integral–differential equation in a single scalar function F of the absolute velocity, by the usual assumption that the distribution function is proportional to the product of F times the Maxwellian distribution times the cosine of the angle between the particle velocity and the direction of the applied gradient. The resulting integral–differential equation is solved by expressing the function F as a set of unknown values (150) spaced equally over the important range of velocities. The derivatives are expressed in terms of these unknown values using five-point difference formulas, while the integrals are expressed using Simpson's rule. This leads to a set of 150 simultaneous equations which are solved on a digital computer. By proper specialization of the dielectric constant in the Balescu equation, the Fokker–Planck case may be obtained, and the resulting integral–differential equation can be shown to be that obtained by Spitzer and Härm, in which case the solution here agrees with that of Spitzer and Härm as it should. The computed results for the Balescu case show the electrical conductivity 3.3% lower and the thermal conductivity 5.3% higher than for the Fokker–Planck case. Thus, the Fokker–Planck theory is a fair approximation within the accuracy predicted by previous investigators. The method of solution presented seems more straightforward than previous methods, assuming the availability of a modern digital computer, and is believed to be better suited to the plasma problem than either the method of Spitzer and Härm or the polynomial expansion methods employed by other investigators. It also appears that further investigation is needed at small impact parameters to improve the approximations made there. (TSS) (Disser. Abstr.)

31833 STUDY OF THE MOBILITY OF IONS PRODUCED IN RARE GAS PLASMAS. Madson, James Merle. Minneapolis, Univ. of Minnesota, 1967. 106p.

Thesis.

The method employed for measuring the ion mobility is the transit-time method. The ions are mass identified by means of a quadrupole mass spectrometer. The drift tube and the mass spectrometer section are separated by a copper diaphragm containing a centrally located 100-micron aperture. The ions to be studied are extracted from a dc discharge and accelerated into a pre-drift region which is maintained at the same E/p_0 ratio as the drift region. The drift tube is operated as a double shutter tube. The first shutter is located at the entrance to the drift region and the second at the entrance to the mass spectrometer. A pulse of ions (1 μsec) is gated into the drift region through a coplanar alternating grid. Some of the ions which cross the drift region under the influence of a uniform electric field pass through the aperture and into the region of the entrance grid to the mass spectrometer. This grid is gated open at a time continuously delayed with respect to the entrance grid to the drift region. When the delay time equals the transit time, the ions pass through the grid, enter the mass spectrometer and are detected by an ion multiplier. The discharge and gating assembly in the drift tube is movable to permit measurements at different drift distances. The drift velocities are calculated using the differential distances and transit times from two measurements. Results obtained in helium for the mobility of the atomic helium ion are consistent with previously reported values. The curve obtained by plotting the mobility versus the E/p_0 ratio for the molecular ion, He_2^+, shows a transition in the value of the mobility from 16.7 cm^2(volt-sec)$^{-1}$ at low E/p_0 ($E/p_0 < 3$ volts (cm-torr)$^{-1}$) to about 20.5 at high E/p_0 ($E/p_0 > 12$ volts (cm-torr)$^{-1}$). The present results for the mobility of $He_2{}^+$ are in excellent agreement with other recently reported values for $E/p_0 < 10$ volts (cm-torr)$^{-1}$. The mobility of the Ne^+ impurity ions in helium appears to be about 20 cm^2(volt-sec)$^{-1}$. Three ions present in argon have been identified as Ar^+, Ar_2^+, and Ar^{++} and their mobilities are consistent with the zero field mobility values of $\mu_0(Ar^+) = 1.5$ cm^2 (volt-sec)$^{-1}$, $\mu_0(Ar_2^+) = 1.8$ cm$^+$(volt-sec)$^{-1}$, and $\mu_0(Ar^{++}) = 2.6$ cm^2 (volt-sec^{-1} as reported by Beaty. Mobility measurements made in krypton using a dc pulsed discharge ion source yielded values for the mobility of Kr^+ in krypton consistent with those reported by Varney. The approximate value of the mobility of Xe^+ ions in krypton is 1.4 cm^2(volt-sec)$^{-1}$ and of KrH^+ in krypton is 1.3 cm^2 (volt-sec^{-1}). (TSS) (Disser. Abstr.)

31834 EXPERIMENTAL INVESTIGATION OF MICROWAVE HARMONIC GENERATION IN A PLASMA. Asmussen, Jes Jr. Madison, Wis., Univ. of Wisconsin, 1967. 172p.

Thesis.

A study of harmonic generation in a microwave discharge is investigated both theoretically and experimentally. An extensive review of both the theoretical and experimental literature is presented and the salient high-power laboratory sources of harmonic power are indicated. A nonlinear one-dimensional mathematical model is developed. This model, called a plasma capacitor, includes the reactive spatial variation of E nonlinearities which under the proper plasma conditions can generate strong harmonics. The capacitor model was adopted for two reasons: (1) the one-dimensional nature of the problem simplifies the nonlinear boundary value problem somewhat while still retaining the basic physical nonlinear processes involved; (2) the experimental plasma geometries employed were close if not identical to the capacitor model. The nonlinear analysis indicates a resonance in harmonic output at $n\omega_1 = \omega_p$ where $n = 2, 3, \ldots$. This first resonance is the ordinary cold plasma resonance. A group of closely spaced resonances centered around $n\omega_1 \gtrsim \omega_p$ are also indicated by the theory. These are harmonic "Tonks–Dattner" resonances. Harmonic generation in a number of gases is investigated experimentally. Third harmonic efficiencies of up to 6% and third harmonic output powers in excess of 600 mw are reported. Double probe measurements of plasma density and electron temperature substantiate the nonlinear plasma capacitor theory: that is for high harmonic output the plasma density is such that $3\omega_1 = \omega_p$. Additional harmonic resonant behavior in capacitor plate spacing, pressure and power input are explained as Tonks–Dattner harmonics. These results lend further support to the nonlinear plasma capacitor model. In order to explain the variations in harmonic power output that occur in different gases, a new graphical method of analysis, based on experimental fact and pressure–collision frequency–electron energy curves, is presented. This method of analysis yields results that compare with experimental observations, but can also be used to design and predict the performance of frequency multipliers. (Disser. Abstr.)

31835 SOME SPHERICALLY SYMMETRIC SOLUTIONS OF THE TIME-INDEPENDENT BOLTZMANN–VLASOV EQUATIONS. Wood, Lawrence Hugh. University, Ala., Univ. of Alabama, 1967. 116p.

Thesis.

The Boltzmann–Vlasov equations are fundamental to many plasma physics problems and when reduced to the time-independent spherically symmetric form permit detailed analysis of spherical diodes and spherical probes. The principal equation which must be investigated in time-independent situations is the Poisson equation. An improved formalism is presented for calculating the charge density term in Poisson's equation and the current-voltage characteristic of either an electrostatic probe or a plasma diode. The charge density integrals in the Poisson equation contribute nonlinear terms which are implicit functions of the electrostatic potential; accordingly, self-consistent, numerical techniques are necessary to obtain specific results. Several representative diode and probe cases are analyzed and the current–voltage characteristic for a spherical probe in an infinite plasma is presented. (Disser. Abstr.)

31836 CYCLOTRON ECHO MEASUREMENT OF ELECTRON MOMENTUM AND ENERGY RELAXATION IN PLASMAS. Hill, R. M.; Kaplan, D. E. (Lockheed Palo Alto Research Lab., Calif.). pp 1229-33 of Magnetic Resonance and Relaxation. Blinc, R. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From International Conference on Magnetic Resonance and Relaxation, 14th Colloque AMPERE, Ljubljana, Yugoslavia. See CONF-660924.

Echoes were observed in partially ionized noble gases over a wide range of gas pressure and electron density for which the dominant collisions occur between electrons and neutral atoms and in fully ionized plasmas for which only collisions between charged particles occur. Possible extensions of this resonance-probing technique to solids and liquids are indicated. (TSS)

31837 OBSERVATION OF PLASMA VORTICES AND THEIR MAGNETIC FIELDS INSIDE A CONICAL THETA-PINCH. Valsamakis, E. A. (Grumman Aircraft Engineering Corp., Bethpage, N. Y.); Small, R. L.; Bostick, W. H. AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 6: 1161-3(June 1968).

Magnetic probes were used to investigate the plasma inside the conical coil region with the aim of providing information about generation of the plasma vortex structures. Results are described. (M.O.W.)

31838 THERMAL REGIME OF THE POSITIVE COLUMN OF A GAS DISCHARGE. Eletskii, A. V.; Mishchenko, L. G.; Tychinskii, V. P. Zh. Prikl. Spektrosk., 8: 425-8(Mar. 1968). (In Russian).

A quantitative analysis of the distribution of the gas temperature across the positive column of the glow discharge was made. Under conditions close to those which are realized in output gas lasers, the equation of the heat conductivity was derived with consideration of the dependence of the heat conductivity coefficient on the temperature. It was shown that in the conditions considered, the calculation of the transverse gradient of the field is possible with high precision. The transverse distribution of the gas temperature is satisfactorily described by functions dependent on one parameter— ratio of the P_1 linear density scattered in the column to the thermal conductive coefficient of the gas K_0. The possibility of decreasing the gas temperature in the discharge was considered. (tr-auth)

31839 SCATTERING OF SUPRALUMINOUS PLASMA WAVES BY INHOMOGENEITIES. Lerche, I. (Univ. of Chicago). Phys. Fluids, 11: 1198-1206(June 1968).

The far-field electromagnetic radiation produced when a field of supraluminous longitudinal plasma oscillations is incident on a localized inhomogeneity in the thermal plasma density is calculated.

The plasma is assumed collisionless and is composed of stationary ions and thermal electrons. The calculation makes use of the thermal equilibrium spectrum of supraluminous waves (with phase velocities greater than the speed of light), which do not Landau damp. The generation and maintenance of this supraluminous spectrum are discussed elsewhere. Upon inserting numerical values for typical laboratory plasmas and also for a typical astrophysical radio source, such as the Crab nebula, it is demonstrated that the phenomenon is completely negligible in the laboratory but can be important in astrophysical systems. (auth)

31840 MAGNETICALLY INDUCED CURRENT CHOPPING IN LOW-PRESSURE DISCHARGES. Tuma, D. T.; Ware, A. A. (Aerojet-General Corp., San Ramon, Calif.). Phys. Fluids, 11: 1206-15(June 1968).

Current chopping has been magnetically induced in low-pressure (2×10^{-5} to 5×10^{-3} torr) arcs carrying currents of 50 to 200 A. The chopping was achieved in a time duration of 1 to 10 μ sec using θ-pinch or an axially uniform magnetic field. Voltage spikes across the arc larger than 80 kV accompanied the chopping when an 8-mH inductor was connected in series with the arc circuit. Irregular oscillations of frequencies higher than 10 MHz were detected during current chopping; the amplitude of the oscillations was proportional to the voltage spike. Other oscillations whose frequency range extended from 100 to 200 kHz were detected, preceding and following the current chopping. X rays were emitted from the arc at current chopping, whose flux depended on the voltage spike. (auth)

31841 OPERATION OF A THETA PINCH AT EXTREMELY LOW FILLING PRESSURES. Kunze, H.-J.; Gabriel, A. H. (Univ. of Maryland, College Park). Phys. Fluids, 11: 1216-20 (June 1968).

Observations are reported that by adding methane to the hydrogen or deuterium filling in the discharge tube of a theta pinch the absolute density at which it is possible to achieve breakdown in the preheater phase can be lowered. Plasma conditions have been investigated for a filling gas pressure of 0.8-mtorr pure CH_4 or CD_4, respectively, using light scattering and neutron emission. Measurements on impurity concentrations indicate that for low filling pressures and low absolute impurity concentrations, selective injection and loss of impurities to the walls during the preheater phase of a theta pinch may become important. Large errors can then arise in determining the concentration of elements with physically stable condensable forms (e.g., carbon and boron) when using the method involving the measurement of the intensity of an emitted spectral line as a function of added impurity concentration. (auth)

31842 FARADAY ROTATION MEASUREMENTS ON THE SCYLLA IV THETA PINCH. Gribble, R. F.; Little, E. M.; Morse, R. L.; Quinn, W. E. (Los Alamos Scientific Lab., N. Mex.). Phys. Fluids, 11: 1221-6(June 1968). (LA-DC-8988).

Faraday rotation measurements have been combined with Mach–Zehnder interferometer measurements to yield the value of the internal magnetic field B_i in the Scylla IV plasma as a function of time and radius. Since the Faraday rotation is proportional to $\int B_i(l)n_e(l)\,dl$ and the Mach–Zehnder interferometer provides $\int n_e(l)\,dl$, the data give the average value of the internal magnetic field $B_i(r)$ which exists over the plasma length l at the radius r. The measurements of $B_i(r)$ are combined with those of the external magnetic field B_e to determine the average plasma β as a function of radius, $\beta = 1 - B_i^2(r)/B_e^2$. The Faraday rotation measurement employs a 1.5-mm-diam beam of visible radiation (6328Å) from a He–Ne gas laser as a plasma magnetic-field probe and a calcite Wollaston prism as the polarization analyzer with silicon diode detectors. In the low-pressure plasma regime (10 to 25 mtorr) the β values in the central plasma-core (~5-mm diameter) range in value between 0.9 and 1.0 with initial reversed bias magnetic fields and between 0.7 and 0.95 without bias fields. Radial profiles of β averaged over the plasma length have been obtained at various times during the discharge. A combination of β, n, and T_e in the simple pressure balance yields ion temperatures in the 2 to 6-keV region. (auth)

31843 ACCELERATION OF PLASMA BY A PROPAGATING CURRENT SHEET. Burton, Rodney L. (Univ. of California, San Diego, La Jolla); Jahn, Robert G. Phys. Fluids, 11: 1231-7 (June 1968).

The structure of a propagating current sheet in a linear pinch discharge in argon is examined with magnetic and electric probes, and interpreted from a magnetogasdynamic point of view. From an integration of the j_zB_θ distributions it is deduced that the bulk of the initial mass fill of the chamber is radially accelerated to the current sheet velocity. Acceleration of ions in the sheet is partially accomplished by a radial electric field, which imparts about half of the necessary energy. The remaining energy is acquired through a $j_z^+B_\theta$ force applied to the ions, which are deflected axially as they pass through the sheet, and, therefore, conduct a large fraction of the axial current. (auth)

31844 SPHERICAL-HARMONIC AND POWER-SERIES EXPANSION OF THE BOLTZMANN EQUATION. Morrone, Terry (Adelphi Univ., Garden City, N. Y.). Phys. Fluids, 11: 1227-30 (June 1968).

The spherical-harmonic expansion of the Boltzmann equation is expanded in a power series in a small parameter, the average fraction of energy an electron loses per collision. The power-series expansion permits an ordering in magnitude of the expansion coefficients of the distribution function, and thus indicates that many terms in the equations relating to the coefficients may be neglected. (auth)

31845 OBSERVATION OF PLASMA WAVE ECHOES. Malmberg, J. H.; Wharton, C. B.; Gould, R. W.; O'Neil, T. M. (Gulf General Atomic Inc., San Diego, Calif.). Phys. Fluids, 11: 1147-53(June 1968).

Experimental observation of a new nonlinear plasma phenomenon, the plasma wave echo, is reported. A recent theory predicts that if a longitudinal electron plasma wave is excited at one position in a collisionless plasma and Landau damps away, and a second wave is excited at another position and also damps away, then a third wave (i.e., the echo) will spontaneously appear at a third position. The existence of various echoes, associated with various orders of the perturbation theory, is demonstrated experimentally. The echoes appear at the predicted position in the plasma. The frequency of the echo wave and the dependence of its amplitude on the amplitude of the initial wave are also in agreement with the theory. Experimental data on the saturation of echo amplitude with increasing initial wave amplitude and increasing distance are given. Data are also presented on another new, but related, phenomenon "the sheath echo." (auth)

31846 NUMERICAL SOLUTION OF PLASMA WAVE EQUATION FOR A LINEAR CONFINING POTENTIAL. Horton, C. W. Jr. (Univ. of California, San Diego, La Jolla). Phys. Fluids, 11: 1154-61(June 1968).

The linearized Vlasov and Poisson equations governing electron plasma oscillations are solved numerically for the case of a Maxwellian electron gas confined by a linear potential. An iterative method of solving the wave equation is developed using a local Fourier transform to demonstrate convergence of the method. The numerical solution verifies and extends the results obtained analytically with the WKB theory by Berk, Horton, Rosenbluth, and Sudan. The reflection coefficient obtained from the numerical solution is compared with the first-order WKB reflection coefficient. The numerical calculation demonstrates that the higher-order reflection processes are smaller than the first-order process. (auth)

31847 EXACT, STATIONARY WAVE SOLUTIONS OF THE NONLINEAR VLASOV EQUATION. Abraham-Shrauner, Barbara (Washington Univ., St. Louis). Phys. Fluids, 11: 1162-7 (June 1968).

A procedure for systematically calculating a wide class of exact, nonlinear wave solutions of the Vlasov equation that are stationary in the wave frame is given. The essential feature of the method is the expansion of the current density in an infinite series of the vector potential or the expansion of the charge density in an infinite series in the scalar potential. The potentials obey a differential equation of the form of the equation of motion for a point particle in a conservative potential. This nonlinear differential equation has numerous analytic solutions depending on the choice of physical parameters. (auth)

31848 ELECTRON-PLASMA WAVE AMPLITUDES ASSOCIATED WITH PARTICLE PHASE MIXING. Rand, S. (Univ. of California, San Diego, La Jolla). Phys. Fluids, 11: 1168-72 (June 1968).

The Landau decrement associated with sinusoidal electron-plasma wave propagation undergoes decaying oscillations in time. The weakening of the oscillations between growing and damped waves is due to phase mixing of resonance particle motions. The rate of phase mixing is increased by the effects of collisions between resonance electrons and the bulk of the plasma particles. The phase mixing problem has been studied, and it is found that the amplitude of the oscillations in the Landau decrement decreases inversely with the square root of the time for early times, and inversely with the seven-halves power for late times. (auth)

31849 STABILITY OF ELECTROMAGNETIC WAVES PROPAGATING PERPENDICULAR TO A UNIFORM MAGNETIC INDUCTION. Hamasaki, Seishi (Univ. of Wisconsin, Madison). Phys. Fluids, 11: 1173-6(June 1968).

The general dispersion formulas of plasma waves propagating perpendicular to an applied uniform magnetic field B_0 in an infinite plasma are derived. Stability of one of the wave modes, a linearly polarized electromagnetic wave whose electric field is directed along B_0, is analyzed under the assumption that the wavelength is much larger than the cyclotron radii of electrons. The analysis shows that the waves are stable for a low-density plasma. However, if the plasma density becomes sufficiently high such that the plasma frequency becomes higher than the electron cyclotron frequency, then an instability may develop. The stability criterion is compared with and is analogous to the criterion for the firehose instability, the allowable frequency range for this mode is analyzed, and it indicates that there is no longer a low-frequency cutoff in the rigorous sense for a hot plasma. (auth)

31850 EFFECTS OF ION-ATOM COLLISIONS ON THE PROPAGATION AND DAMPING OF ION-ACOUSTIC WAVES. Andersen, H. K.; D'Angelo, N.; Jensen, V. O.; Michelsen, P.; Nielsen, P. (Risoe Research Establishment, Roskilde, Denmark). Phys. Fluids, 11: 1177-80(June 1968).

Experiments are described on the ion-acoustic wave propagation and damping in alkali to plasmas of various degrees of ionization. An increase of the ratio T_e/T_i from 1 to approximately 3 to 4, caused by ion-atom collisions, results in a decrease of the (Landau) damping of the waves. At high gas pressure and/or low wave frequency a "fluid" picture adequately describes the experimental results. (auth)

31851 NONLINEAR TRANSPORT IN WEAKLY IONIZED PLASMA. Simon, Albert (Univ. of Rochester, N. Y.). Phys. Fluids, 11: 1181-5(June 1968).

A set of equations is derived for the amplitudes of the oscillating modes which arise in a slightly unstable weakly ionized plasma. The plasma is initially in a time-independent but spatially dependent and linearly stable equilibrium. It becomes unstable upon a small fractional increase Δ of some external parameter. The amplitudes of the final steadily oscillating states, the frequency shifts of these states, and the transport rates are determined in terms of Δ. (auth)

31852 CHARACTERISTICS OF NOISE IN A TWO-DIMENSIONAL COMPUTER PLASMA. Hockney, R. W. (Stanford Univ., Calif.). Phys. Fluids, 11: 1381-3(June 1968).

The correlation time and root-mean-square value of the E-field fluctuations have been measured in a two-dimensional computer model of a plasma, thus enabling the collision and diffusion rates arising from computer errors to be predicted. (auth)

31853 COMPARISON OF A TWO-DIMENSIONAL SNOWPLOUGH MODEL WITH EXPERIMENT. Basque, G.; Jolas, A.; Watteau, J. P. (CEA, Limeil-Brevannes, France). Phys. Fluids, 11: 1384-6(June 1968).

The current sheath dynamics deduced from a two-dimensional axisymmetric snowplough model fits well with what is photographically observed on a noncylindrical Z-pinch experiment. Relative agreement is found between computed and measured electrical quantities. (auth)

31854 ASYMPTOTIC INTEGRAL PROPERTY OF A DIFFUSION-RECOMBINATION EQUATION. Sherman, Christopher (GCA Corp., Bedford, Mass.). Phys. Fluids, 11: 1335-7(June 1968).

The total number of particles which remain unrecombined in a system of charged particles undergoing simultaneous diffusion and recombination is calculated numerically. The results of this calculation as well as of heuristic arguments indicate that the asymptotic limit of total unrecombined particles as the time becomes infinite is zero for a planar or cylindrical space but is not zero for a spherical space. (auth)

31855 WHISTLER TYPE WAVE PENETRATION OF HOT PLASMAS. Drummond, James E. (Boeing Scientific Research Labs., Seattle). Phys. Fluids, 11: 1196-7(June 1968).

The attenuation of plane, right circular polarized electromagnetic waves propagating along an axial magnetic field into a thermal plasma is computed by an adaptation of Weibel's analytical and numerical results for nonmagnetic field cases. (auth)

31856 REFLECTION AND REFRACTION OF ELECTROMAGNETIC WAVES ON PLASMA IN HOMOGENEOUS MAGNETIC FIELD. Petrus, O.; Deutsch, R. V. (Cuza Univ., Iasi. Polytechnic Inst., Iasi). Rev. Roum. Phys., 13: 81-94(1968).

The reflection and refraction of electromagnetic waves on anisotropic plasma are studied. The dispersion equation for the velocity of reflected waves is obtained in the general case where the polarization of the incident wave is arbitrary, and the magnetic field to which the medium anisotropy is due is arbitrarily directed toward the plasma surface. For the same case, the components of the intensity of the magnetic field of the reflected and refracted waves are investigated. The general results are then applied to some particular cases of the direction of the magnetic field. An experimental method to determine the components of the dielectric permeability tensor is proposed. Finally, the possibility of exciting some plasma oscillations by means of electromagnetic incident waves is studied. (auth)

31857 CONCERNING ONE MECHANISM OF ION-LEVEL RELAXATION IN A PLASMA. Zemtsov, Yu. K.; Slomkovskii, S.; Starosta, V. (Moscow State Univ.). JETP Lett. (USSR) (Engl. Transl.), 7: 162-4(Mar. 1968).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 7: 212-15(Mar. 20, 1968).

The level population of atoms and ions in an equilibrium plasma are determined by the formulas of Boltzmann and Saha. In the case when there is no equilibrium, the level population can be obtained by solving a system of equations describing the particle balance for each state. The coefficients of such an equation are the velocities of different collision and radiation processes: excitation and ionization by electron impact, impacts of the second kind and triple recombination, spontaneous emission and photorecombination, photoabsorption, and stimulated emission (in lines and in the continuous spectrum). (M.O.W.)

31858 SOME EXPERIMENTAL RESULTS FROM A NONEQUILIBRIUM RF DISCHARGE. Boedeker, Laurence R.; Haldeman, Charles W. (Massachusetts Inst. of Tech., Cambridge). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 6: 538-40(Mar. 1968).

Nonequilibrium properties of a radio-frequency discharge are being investigated for application to a traveling-wave accelerator. In this note, general operating conditions of the discharge are discussed. Experimental information shows that a reasonably symmetric discharge can be obtained and that significant nonequilibrium ionization can be achieved. It is also shown that electron average energy is increased substantially and the non-Maxwellian character of the electron energy distribution function is enhanced as the ratio of applied frequency, $\omega/2\pi$, to electron collision frequency, ν_c, approaches unity. Information is also provided on plasma electrical conductivity. Data have been obtained using air and argon. (M.O.W.)

31859 PROPAGATION OF WEAK DISTURBANCES IN AN IDEAL PLASMA IN PRESENCE OF RADIATION. Cristea, M. Stud. Univ. Babes-Bolyai, Ser. Math.-Phys., 13: 131-8(1968). (In Rumanian).

Propagation of weak disturbances in an ideal plasma in presence of radiation is investigated. The equation of dispersion is obtained and then the solutions of this equation for some particular cases are deduced. (auth)

31860 TRANSPORT COEFFICIENTS OF DEGENERATE PLASMA. Lampe, Martin (Univ. of California, Berkeley). Phys. Rev., 170: 306-19(June 5, 1968).

An improved nonrelativistic calculation, based on the quantum Lenard-Balescu transport equation, is performed for the thermal and electrical conductivity of a plasma of highly degenerate, weakly coupled electrons and nondegenerate, weakly coupled ions. Dynamic shielding in the random-phase approximation is treated correctly, and both electron-ion (ei) and electron-electron (ee) collisions are included in the thermal conductivity. The argument that ee collisions are negligible, because the Pauli exclusion principle limits their effect to $(kT/E_F)^2$ less than that of ei collisions, is refuted in the case of the thermal conductivity. For temperatures of about 10^8 °K and densities of 10^{26} to 10^{30} electrons/cc, appropriate to red-giant stellar cores, ee collisions reduce the thermal conductivity by 25 to 50%. However, ee collisions are insignificant in terrestrial solids. The thermal conductivity κ is given by $1/\kappa = 1/\kappa_{ei} + 1/\kappa_{ee}$, where κ_{ei} and κ_{ee} are conductivities determined by ei and ee collisions, $\kappa_{ei} \propto Tn/[\ln(1/\lambda_i) + C_{ei}]$, where $\lambda_i^2 \ll 1$ is the ion weak-coupling parameter, and the correction C_{ei} involves dynamic shielding. If $\lambda^2 \ll 1$ is the electron weak-coupling parameter, and $\lambda \equiv 4\lambda E_F/kT \gg 1$, then $\kappa_{ee} \propto \lambda^3 n^{1/3} T^{-1}$, instead of the usual logarithmic form. If $\gamma \ll 1$, then $\kappa_{ee} \propto T^2 n^{1/3}/[\ln(1/\gamma) + C_{ee}]$, with the temperature dependence contrary to Fermi-liquid theory. (auth)

31861 NEW THEORY OF ELECTRON DRIFT VELOCITY IN GASES. Cavalleri, G.; Sesta, G. (Centro Informazioni Studi Esperienze, Milan). Phys. Rev., 170: 286-93(June 5, 1968).

The electron drift velocity is usually obtained on the assumptions that: (i) the velocity variation due to the electric field is small compared to the thermal velocity, and (ii) the inelastic collision rate is negligible with respect to the elastic collision rate. By introducing the distribution function $f_0(c_0)$ of the velocities c_0 immediately after a collision ("initial" distribution function), we develop a new theory which obviates the above assumptions and is therefore particularly suitable in the case of high values of the ratio between the electric field and the gas pressure. The drift velocity is obtained by two successive steps. First we obtain a rigorous expression for the drift velocity $w(c_0)$ of electrons having initial velocity c_0. By expanding this expression to first order under assumption (i) only, the usual expression for $w(c_0)$ is found again, and its validity is therefore extended even to the case of inelastic collisions, since assumption (ii) has not been used. In order to obtain the drift velocity W, the expression for $w(c_0)$ must be averaged over the initial distribution function $f_0(c_0)$. The initial velocity distribution, not being affected by the electric field, is isotropic when the differential collision cross section is isotropic. Therefore, the resulting integral equation for $f_0(c_0)$, though rigorous, has the same simplicity as the usual first-order expansion of the Boltzmann equation. (auth)

Production of Plasma

31862 ANALYSIS OF A STEADY-STATE PLASMA ACCELERATOR UTILIZING RADIOISOTOPE HEAT SOURCES. Shaw, David Tai-ko (State Univ. of New York, Buffalo). Trans. Amer. Nucl. Soc., 11: 15-16(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31863 DEVELOPMENTS IN THE AREA OF PLASMA PHYSICS. Lochte-Holtgreven, Walter (Univ., Kiel). Umsch. Wiss. Tech., 68: 65-70(Feb. 1, 1968). (In German).

A number of methods for the production of hot plasmas are briefly described. These include conventional shock wave tubes, electromagnetic shock wave tubes, linear pinch devices, θ-pinch devices, and exploding liquid wires. The most important results obtained with each are reported. (J.S.R.)

31864 VOLT-AMPERE CHARACTERISTICS OF METALLIC ELECTRODES IN THE IONIZED GAS FLOW. Golodnyak, V. A.; Kazakevich, O. Ya.; Ustimenko, L. Yu. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 2, 111-14(1967). (In Russian).

Experimental data are given on the electric current flow between cooled and non-cooled metallic electrodes. Volt–ampere characteristics of the electrode–plasma–electrode gap and the relation between the circuit current and electrode surface temperature are found. A visual method describing electrode characteristics as a tri-dimensional (I, U, and T) diagram is included. (tr-auth)

Stability of Plasma

31865 (ORO-3405-20) INVESTIGATION OF UNIVERSAL PLASMA INSTABILITIES. Annual Progress Report No. 3. Lashinsky, H. (Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics). June 1, 1968. Contract AT(40-1)-3405. 19p. Dep. CFSTI.

Operation of the University of Maryland Q device during this period is described. Brief summaries of experimental and theoretical research are given for the following: coupled-mode analysis of plasma drift instability, periodic pulling, mode competition in drift instabilities, electron-bombardment diode for the Q device, active microwave network for determination of plasma parameters, temperature control system for long thermal lag, raster display, digital readout for shaft rotation, and liquid air level controller. (M.O.W.)

31866 (ORNL-4238 pp 1-27) PLASMA THEORY AND COMPUTATION. (Oak Ridge National Lab., Tenn.).

Loss cone instabilities are discussed, taking into account different electron and ion temperatures. Some preliminary work on oscillations and instabilities in finite plasma is described. (M.O.W.)

31867 (ORNL-4238, pp 28-38) INJECTION AND ACCUMULATION: NEUTRAL INJECTION EXPERIMENTS (DCX-1.5). Colchin, R. J.; Dunlap, J. L.; Edwards, R. S.; Massengill, L. A.; Postma, H.; Reinhardt, R. G.; Schill, W. J.; Wells, E. R. (Oak Ridge National Lab., Tenn.).

Detailed studies of the plasma formed in this facility by injection of 20-keV H° were continued. As before, emphasis was given to the properties of the low-frequency instability (the flute) and to those of the two microinstabilities (the θ and Z modes). Most of the data and their implications are discussed. (M.O.W.)

31868 (ORNL-4238, pp 39-58) INJECTION AND ACCUMULATION: MULTIPLE-PASS EXPERIMENTS (DCX-2). Bell, P. R.; Clarke, J. F.; Culver, J. S.; (and others) (Oak Ridge National Lab., Tenn.).

The emphasis this report period has been on the study of microinstabilities occurring in different plasmas in the DCX-2. These instabilities occur at frequencies near harmonics of the ion cyclotron frequency and, for the most part, appear to be Harris like modes, that is, instabilities caused by coupling between perpendicular cyclotron motion of energetic ions and axial plasma oscillations of cold electrons, driven by the anisotropy of the ion velocity distribution function. Three different plasma situations were studied during this period: (1) the energetic proton plasmas obtained by hydrogen arc dissociation and by hydrogen gas dissociation in the presence of the injected H_2^+ beam, that is, the steady-state behavior during the beam-on time; (2) the energetic proton plasma obtained by hydrogen arc dissociation in the absence of the injected beam, that is, during the afterglow period following beam turnoff; and (3) the injected ion beam and its accompanying ionization-produced cold plasma in the absence of the energetic proton plasma, that is, with the normally dominant energetic proton plasma suppressed by the insertion of obstacles. (auth)

31869 SINGULARITY INTERACTION OF THE VARIOUS OSCILLATION MODES IN THE THEORY OF PLASMA STABILITY. Moiseev, S. S. (Novosibirsk State Univ., USSR). pp 183-91 of Problema Mnogikh Tel i Fizika Plazmy. Bonch-Bruevich, V. L. Moscow, Izdatel'stvo Nauka, 1967. (In Russian).

The problems of the stability and wave transformation are investigated in view of the influence of "the points of intersection of solutions" as well as the turning points for various cases. For convenience, one mainly considers the latter oscillations which may be reduced to a differential equation of the 4th order or to the system of two equations of the 2nd order. In case of finite problems one seeks for an oscillation spectrum which essentially depends on the analytical properties of oscillation "modes" $K_1(x)$ and $K_2(x)$. (auth)

31870 QUASI-LINEAR THEORY OF ELECTRON BEAM RELAXATION IN A MAGNETIC-ACTIVE PLASMA. Shapiro, V. D.; Shevchenko, V. I. (Physical-Technical Inst. of Low Temperatures, Kharkov). Zh. Eksp. Teor. Fiz., 54: 1187-1202(Apr. 1968). (In Russian).

Quasilinear relaxation of an electron beam in a plasma in the presence of a strong magnetic field ($\omega_H \gg \omega_0$) is investigated. It is shown that the "plateau" on the longitudinal velocity distribution function ($\partial f/\partial v_z = 0$) produced by Cherenkov excitation is unstable with respect to cyclotron excitation of oscillations on the anomalous Doppler effect. This instability results in an increase of the transverse energy in the beam and in a slope of the longitudinal velocity "plateau" ($\partial f/\partial v_z < 0$). A solution of the quasi-linear set of equations describing the dynamics of this stage of relaxation is obtained. (auth)

31871 PERTURBATION APPROACH TO PLASMA OSCILLATIONS. Sedlacek, Z. (Inst. of Plasma Physics, Prague). Czech. J. Phys., 18: 618-28(1968).

It is shown that the complete spectrum, continuous as well as discrete, and corresponding eigenfunctions of the Vlasov operator can be obtained by a single perturbation procedure from the purely continuous spectrum and corresponding eigenfunctions of the free-streaming operator. In addition an alternative definition of the eigenfunctions is presented and it is shown that the problem of normalizing the continuous eigenmodes is thus solved automatically. (auth)

31872 PLASMA INSTABILITIES EXCITED BY AN AZIMUTHAL ELECTRON BEAM. Jungwirth, K. (Inst. of Plasma Physics, Prague). Czech. J. Phys., 18: 629-34(1968).

The effect of the finite "temperature" $T_\perp$ of an azimuthal electron beam on plasma stability is described. Only instabilities for which the longitudinal macroscopic velocity of the beam is of no importance are discussed. It is shown that at the limit of applicability $T_\perp \approx \frac{1}{2}MV_\varphi^2$ the weak and strong inhomogeneity approximations give the same results. (auth)

31873 STABILIZATION OF TRAPPED-PARTICLE INSTABILITY BY FINITE ORBIT EFFECT. Pogutse, O. P. (Kurchatov Inst. of Atomic Energy, Moscow). Phys. Lett., 27A: 63-6(May 20, 1968).

A stabilization criterion is obtained for trapped particle instability. It occurs due to periodic deviation of the particle guiding centers from the magnetic surfaces. (auth)

31874 EFFECT OF AN AZIMUTHAL MAGNETIC FIELD ON THE HELICAL INSTABILITY IN A HOLLOW POSITIVE COLUMN. Reynolds, James F. Troy, N. Y., Rensselaer Polytechnic Inst., 1967. 130p.

Thesis.

The application of a component of azimuthal magnetic field, B_ϕ, to a hollow positive column in a strong longitudinal magnetic field is shown to stabilize or destabilize the column against the helical instability depending on the direction in which it is applied. When the resulting magnetic field helix has the same sense as the perturbed density helix, the plasma is destabilized. This is accompanied by a switch to a higher order, $m = 2$, mode and higher frequency of rotation of the helix with increasing B_ϕ. When the two helices have opposite senses, the plasma is stabilized. In this case, the $m = 1$ is always the dominant mode of the instability. In addition, the confinement of the plasma in the classical regime is improved for this direction of B_ϕ. A generalized stability theory is derived which predicts the destabilizing and stabilizing effects, the mode switch and the dependence of frequency of rotation of the helix on B_ϕ. The importance of considering the effect of the external magnetic field on the zero-order plasma density is demonstrated. Calculations based on the theory show that the major effect of B_ϕ on the critical value of longitudinal magnetic field is due to the change in the unperturbed or pre-onset density distribution. Measurements have also been made of the radial form of the perturbed plasma density in the hollow column. (Disser. Abstr.)

31875 SCREW INSTABILITY OF A THERMALLY INHOMOGENEOUS POSITIVE COLUMN IN A LONGITUDINAL MAGNETIC FIELD. Kim, Chul Mo. Rochester, N. Y., Univ. of Rochester, 1967. 111p.

Thesis.

The purposes of this investigation are (1) to examine the effects of thermal inhomogeneity and various density distributions associated with it on the screw instability in a positive column and (2) to establish the domain of parameters for which quasi-neutrality is a valid simplification in the analysis of the instability. With the use of the parabolic temperature distribution obtained by Ecker and Zöller and density distributions deviating in various ways from the zeroth-order Bessel function J_0, the curves of the onset of instability for several temperature and density gradients are calculated. To interpret these curves properly, the axial electric field necessary to maintain the discharge is determined by an approximate analysis. It is found that the electric field needed to maintain the discharge in the thermally inhomogeneous case is reduced approximately by the ratio of the ion–neutral temperature at the axis to that at the wall, compared with the electric field in the thermally homogeneous case. As a result, the critical magnetic field reached is larger for the thermally inhomogeneous case than for the thermally homogeneous case. Thermal inhomogeneity is thus found to have a stabilizing influence on screw instability. The results of analysis were found to agree with the experiments of Adati, et al., if it is taken into consideration that temperature distributions corresponding to number density profiles deviating from the zeroth order Bessel function are nonuniform. By perturbing the densities of ions and electrons independently and using the perturbed potential derived by Matsumoto, the domain of parameters for which quasi neutrality is a valid simplification is obtained. The assumption of quasi neutrality is found to introduce less than 1% error, provided the charged particle density is greater than $10^{10}/\mathrm{cm}^3$ for the dimensionless wave number, kR, less than 1.2. In addition, the dependence of the stability curves upon the two parameters, the ratio of ion-neutral to electron temperature and the charged particle density, is examined. For values of the ratio of ion–neutral to electron temperature greater than 10^{-2}, the relative positions of the stability curves are found to be quite dependent upon this ratio; however, for ratios less than 10^{-2} the curves approach the curve for zero ion–neutral temperature. Values of charged particle density less than $10^{10}/\mathrm{cm}^3$ significantly alter the stability curves, while for values greater than $10^{10}/\mathrm{cm}^3$, the curves approach the curve for quasi neutrality. It is also found that the usual stabilizing azimuthal drift $\vec{E}_r \times \vec{B}$ becomes a destabilizing influence for a large magnetic field. Therefore, a qualitative prediction of the critical magnetic field follows from an examination of the steady-state azimuthal drift. (Disser. Abstr.)

31876 RESISTIVE INSTABILITIES OF A VISCOUS FLUID WITH HORIZONTAL BOUNDARY. Zadoff, Leon N.; Begun, Martin (Fairchild Hiller Corp., Farmingdale, N. Y.). Phys. Fluids, 11: 1238–44(June 1968).

The gravitational instabilities of a system consisting of two homogeneous fluids with horizontal interface, in the presence of a uniform horizontal magnetic field, are investigated. The fluids are incompressible and have finite electrical conductivity and viscosity. The dispersion relation, which is obtained for the general case, is then specialized for a lower fluid of vanishing density, viscosity, and conductivity. In the limit of infinite conductivity in the upper fluid, the resulting dispersion relation corresponds to that previously obtained for a conducting fluid supported by a magnetic field against gravity. For finite conductivity in the upper fluid, this procedure avoids the difficulties involved as a result of diffusion across a supporting magnetic field. The effects of viscosity and resistivity on the Rayleigh–Taylor modes are obtained. In addition, a resistive gravitational interchange instability is found, although magnetic shear is absent. It is further established that a small viscosity diminishes the growth rate of the resistive gravitational instability. (auth)

31877 EXPERIMENTAL INVESTIGATIONS OF THE POSSIBILITY OF CONTROLLING TWO-STREAM INSTABILITY WITH THE AID OF MODULATION. Berezin, A. K.; Fainberg, Ya. B.; Bez'yazychnyi, I. A. (Physical-Technical Inst., Kiev). JETP Lett. (USSR) (Engl. Transl.), 7: 119-23(Mar. 1968).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 7: 156-60(Mar. 5, 1968).

The question of the control of two-stream instabilities by initially modulating the beam and by introducing an initial nonfluctuating disturbance from an external source is investigated. It is shown that the intense high-frequency oscillations excited as a result of the development of a two-stream instability with a power on the order of 100 kW can be controlled by applying to the input of the beam–plasma system a very weak regular signal which is smaller by a factor 10^5 to 10^6 than the power of the excited oscillations. (M.O.W.)

31878 MAGNETIC WELLS PRODUCED BY A BEAM CURRENT. Ohkawa, Tihiro (Gulf General Atomic Inc., San Diego, Calif.). Phys. Fluids, 11: 1383–4(June 1968).

The stability condition of interchange instability for plasmas confined in a magnetic well produced by beam current is discussed. (auth)

31879 GUIDING-CENTER TREATMENT OF FINITE GYRORADIUS FLUID EQUATIONS. Emmert, G.; Schmidt, G. (Stevens Inst. of Tech., Hoboken, N. J.). Phys. Fluids, 11: 1379–81(June 1968).

The finite gyroradius fluid equations of Rosenbluth and Simon are derived from guiding-center theory with finite gyroradius corrections. This derivation is simpler and physically more transparent than the original derivation. (auth)

31880 CONVECTION OF WEAKLY IONIZED PLASMA IN A NONUNIFORM MAGNETIC FIELD. Simon, Albert (Univ. of Rochester, N. Y.). Phys. Fluids, 11: 1186-91(June 1968). (UR-3942-2).

A weakly ionized plasma in a nonuniform magnetic field exhibits an instability analogous to the well-known flute instability of a fully ionized plasma. The instability sets in at a critical magnetic field. When this external field is slightly increased above the critical value by the fractional amount Δ, to begin with only one mode goes unstable and it grows in amplitude to a finite limiting value. Using a general theory of the nonlinear behavior derived in an accompanying paper, we evaluate the mode amplitude and frequency shift as functions of Δ, as well as the corresponding enhanced particle transport. The results are first obtained in the quasilinear approximation, but it is then shown that the mode-coupling contribution is negligible and hence that the result is generally valid for small Δ. (auth)

31881 STABILITY OF PLASMA SHEATHS. Schindler, K. (European Space Research Inst., Frascati, Italy); Soop, M. Phys. Fluids, 11: 1192–5(June 1968).

The stability of plasma in a magnetic field against collision-free tearing of current layers is considered in plane geometry. While previous studies were confined to specific equilibria without charge separation, the present (variational) approach allows for a large class of distribution functions and for an equilibrium electrostatic field, thus also applying to strongly inhomogeneous equilibria. A simple criterion is obtained, which is necessary and sufficient for stability against perturbations that do not vary along the direction of the equilibrium current (tearing mode). Strictly one-dimensional perturbations requiring a somewhat modified procedure are discussed separately. (auth)

Thermonuclear Processes

31882 CONTROLLED NUCLEAR FUSION TODAY AND FUTURE PROSPECTS. Lehnert, Bo. (Kungliga Tekniska Hogskolan, Stockholm). FOA (Forsvarets Forsk.) Rep., 1: 1-14(July 1967). (In Swedish).

The present state of the research on controlled thermonuclear fusion and its possibilities are summarized. For the controlled release of fusion energy in a reactor, a fully ionized gas of heavy hydrogen has to be kept at a temperature of the order of millions of degrees Kelvin during times of the order of seconds. A self-sustained fusion reaction is therefore only possible if the ionized gas (the plasma) is prevented from getting into contact with the walls of the reaction chamber in a very efficient way. The most promising method in this respect is to use a magnetic field in the shape of a "magnetic bottle" which confines the plasma. In addition to this, methods are required for the heating of the plasma to the necessary temperature range, as well as a number of technical arrangements for the generation of the magnetic field and the development of the reaction chamber. At the present stage, the fusion problem is mainly of a plasma physical nature. Two of the outstanding questions in this connection are the particle losses from the magnetic bottle and the stability of the equilibrium state of the confined plasma. So far it has not been possible to realize the conditions of a self-sustained fusion reaction in the laboratory. The main reason for this is that it has not yet been possible to eliminate the particle losses and instability phenomena completely at the same time in the same device. However, considerable progress is being made in the understanding of plasma physics and of magnetic confinement. Thus, there now exist methods for the suppression of some of the most important instabilities in devices where the particle losses have a good chance of being kept at a low level. According to present knowledge, it is possible that thermonuclear fusion research will lead to success within a surveyable future. (tr-auth) (TSS)

Shielding

Refer also to abstracts 32372, 32424, 32442, and 32447.

31883 (JUL-509-ST) SCHWAECHUNGSFAKTOREN ZUR BERECHNUNG DER ABSCHIRMUNG MONOENERGETISCHER γ-STRAHLUNG DURCH SCHWER- UND SCHWERSTBETON. (Diminution Factor for Calculation of the Shielding of Monoenergistic γ rays through Heavy and Very Heavy Concrete). Sauermann, P. F.; Crommen, F. (Kernforschungsanlage, Juelich (West Germany). Zentralabteilung Strahlenschutz). Dec. 1967. 17p. (In German). Dep.

The Gussew attenuation factors for the shielding of γ radiation in various shielding materials are very suitable for the rapid evaluation of the effect of shielding, but attenuation factors are lacking for materials whose density is between that of normal concrete ($\rho = 2.3$ g/cm^3) and iron ($\rho = 7.8$ g/cm^3). In radiation protection it is necessary in many cases, however, to replace normal concrete with heavy or very heavy concrete, which permits a considerable reduction of the thickness of the shields. Attenuation factors for γ energies from 0.5 to 10 MeV were calculated for a number of heavy and very heavy concretes with densities from 2.35 to 4.82 g/cm^3. The results are given in the form of tables and diagrams. (tr-auth)

31884 (ORNL-RSIC-20) METHODS FOR CALCULATING EFFECTS OF DUCTS, ACCESS WAYS, AND HOLES IN RADIATION SHIELDS. Selph, Wade E.; Claiborne, H. Clyde (Oak Ridge National Lab., Tenn.). Jan. 1968. Contract W-7405-eng-26. 45p. (DASA-1892-1). Dep. CFSTI.

A weapons radiation shield is usually considered to be a thick-walled structure which surrounds a central cavity and is penetrated by a circular or rectangular duct. The radiation source is incident on the outside of the structure and enters the structure both by penetrating shielding material and by following the path of the duct. For straight ducts the component that should contribute most to the dose penetrating the structure is the "line of sight" component which travels uninhibited from the mouth of the duct to the central cavity. Analytic methods for calculating this component are presented. Another component is the radiation that reaches the duct through the surrounding shielding material, either as uncollided radiation that entered the shield in the direction of the duct or as radiation that is scattered by the shielding material into the duct. The ray analysis technique for handling these components is discussed. A number of analog Monte Carlo computer programs are available for the calculation of more complicated duct geometries or for higher accuracy for the simple geometries. Since the computer time for these is prohibitive, modified Monte Carlo programs developed for neutron transmission calculations which employ albedo theory to estimate reflectance from the duct walls are discussed along with other albedo techniques devised for estimating gamma-ray transmission. A few techniques are presented for calculating the effects of holes or depressions in shields. Both single large voids and smaller voids distributed throughout the shield are considered. (M.H.R.)

31885 (ORNL-RSIC-21) NEUTRON AND GAMMA-RAY ALBEDOS. Selph, Wade E. (Oak Ridge National Lab., Tenn.). Feb. 1968. Contract W-7405-eng-26. 51p. (DASA-1892-2). Dep. CFSTI.

This document is a reprint of Chapter 4 of Weapons Radiation Shielding Handbook.

The albedo data obtained to date are summarized and the gaps that still exist are emphasized. For example, while calculated neutron albedos for concrete are available for essentially all energy regions of interest, those for the intermediate-energy range lack experimental confirmation. Experimental confirmation of gamma-ray albedo calculations is even more limited. In the case of secondary gamma-ray albedos, there has been almost no experimental confirmation. All the albedo data has been classified according to definitions given here in order to bring order to the field. (M.H.R.)

31886 (UCRL-18093) MODULAR NEUTRON SHIELD. Babin, Alexander (California Univ., Berkeley. Lawrence Radiation Lab.). Feb. 1968. Contract W-7405-eng-48. 44p. Dep. CFSTI.

A flexible, low-cost shielding system, consisting of water-filled steel cans and lead bricks, is described. The shield is designed to protect against radiation, primarily from a spontaneous fission source of 50 to 100 μg ^{252}Cf and from a 1-curie gamma source. Because of the modular construction used, shielding wall thickness and overall geometry can be readily modified, in order to attenuate different levels of radioactivity or to accommodate different enclosure sizes. Portable components include plain tank sections, zinc bromide windows, turntable unit, master-slave manipulators, interlocking 2-in. lead bricks, and structural support for assembled shield. (auth)

31887 (ORNL-tr-1912) BUILDUP OF THE CHARGED RADIATION COMPONENT IN A SHIELD. Sychev, B. S. Translated for Oak Ridge National Lab., Tenn., from report JINR-P9-3269. 8p. Dep. CFSTI. JCL $1.10 fs, $0.80 mf.

An abstract of the original Russian report appeared in NSA 21: 29320. (M.H.R.)

31888 TWO METHODS FOR EVALUATING THE SUSCEPTIBILITY OF IRRADIATED GLASS TO FRACTURE BY ELECTRICAL DISCHARGE. Hardtke, F. C. (Univ. of Missouri, Rolla). Trans. Amer. Nucl. Soc., 11: 360(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31889 CALCULATIONS OF FISSION-PRODUCT GAMMA-RAY DOSES IN SINGLE-COMPARTMENT ABOVE-GROUND CONCRETE STRUCTURES. Mooney, L. G.; Wells, M. B. (Radiation Research Associates, Inc., Fort Worth, Tex.). Trans. Amer. Nucl. Soc., 11: 423(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31890 GAMMA-RAY SLANT PENETRATION PROBABILITIES FOR FINITE SLABS. Doggett, Wesley O. (North Carolina State Coll., Raleigh); Bryan, Fred A.; Hunt, Nileen; Hughes, M. A. Trans. Amer. Nucl. Soc., 11: 423-4(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31891 IMPORTANCE SAMPLING IN MONTE CARLO SHIELDING CALCULATIONS BY A COMBINATION EXPONENTIAL AND ENERGY LINEARLY DEPENDENT TRANSFORMATION. Chilton, A. B. (Univ. of Illinois, Urbana). Trans. Amer. Nucl. Soc., 11: 418(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31892 EXTENSION OF THE POLYNOMIAL APPROXIMATION IN MOMENTS METHOD CALCULATIONS TO THE DEEP PENETRATION OF GAMMA RADIATION. Morris, E. E. (Univ. of Illinois, Urbana). Trans. Amer. Nucl. Soc., 11: 418-19(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31893 APPROXIMATE METHOD, INVOLVING SUCCESSIVE SCATTERS, FOR THE CALCULATION OF PHOTON TRANSPORT IN THIN SLAB GEOMETRIES. Bridgman, Charles J.; Moates, Thomas H.; Robertson, William R. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio). Trans. Amer. Nucl. Soc., 11: 419-20(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31894 METHOD FOR APPROXIMATING THE EFFECT OF THE ENERGY DEPENDENCE OF NEUTRON-CAPTURE GAMMA-RAY SPECTRA ON CAPTURE GAMMA-RAY DOSE CALCULATIONS. Yost, K. J. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 417-18(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31895 EFFECT OF TARGET SCATTERING ON THE SHIELDING OF HIGH-ENERGY ELECTRON BEAMS. Jenkins, T. M.; Nelson, W. R. (Stanford Linear Accelerator Center, Calif.). Trans. Amer. Nucl. Soc., 11: 406-7(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31896 COMPUTATION OF ELECTRON TRANSPORT IN DIELECTRICS. Kennedy, Eugene (General Electric Co., Philadelphia); Kholberg, Ira. Trans. Amer. Nucl. Soc., 11: 407-8(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31897 EFFECT OF CROSS-SECTION RESOLUTION ON NEUTRON TRANSPORT AND SECONDARY GAMMA PRODUCTION CALCULATIONS. Celnik, Jacob (United Nuclear Corp., Elmsford, N. Y.). Trans. Amer. Nucl. Soc., 11: 409-10(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31898 TIME-DEPENDENT NEUTRON AND SECONDARY GAMMA-RAY TRANSPORT IN AN AIR-OVER-GROUND GEOMETRY. Straker, E. A. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 410-11(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31899 APPLICATION OF MARKOV TRANSITION MATRICES IN CALCULATIONS FOR THE TIME DEPENDENCE OF NEUTRON SLOWING DOWN IN SHIELDS. McGrath, E. J.; Spencer, R. B. (TRW Systems, Redondo Beach, Calif.). Trans. Amer. Nucl. Soc., 11: 411-12(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31900 ALBEDO MONTE CARLO ANALYSIS OF FAST-NEUTRON TRANSPORT IN A MISSILE LAUNCH TUBE. Selph, W. E.; Newell, J. M.; Bayer, C. E. (Radiation Research Associates, Inc., Fort Worth, Tex.). Trans. Amer. Nucl. Soc., 11: 412-13(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31901 CALCULATIONS OF DEPTH DOSE FROM NEUTRONS AND PROTONS OF HIGH ENERGY AND THEIR INTERPRETATION FOR RADIATION PROTECTION. Snyder, W. S.; Wright, H. A.; Turner, J. E.; Neufeld, Jacob (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 391(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31902 NEUTRON STREAMING THROUGH CONCRETE DUCTS Song, Yo Taik (Univ. of Tennessee, Knoxville); Chilton, A. B.; Huddleston, C. M. Trans. Amer. Nucl. Soc., 11: 413-14(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31903 MULTIPLE COULOMB SCATTERING OF HIGH-ENERGY PROTONS. England, L. D.; Nelson, J. B.; Blake, K. R.; Parker, C. V.; Boles, L. A. (Texas Nuclear Corp., Austin). Trans. Amer. Nucl. Soc., 11: 404(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31904 STUDY OF THE PROPAGATION OF THE NEUTRON CASCADE IN IRON. O'Brien, Keran (United States Atomic Energy Commission, N. Y.). Trans. Amer. Nucl. Soc., 11: 394-5 (June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31905 ACCELERATOR NEUTRON SPECTRA AND SPECTRA TO DOSE CONVERSION. Gilbert, W. S.; Patterson, H. W.; Smith, A. R. (Univ. of California, Berkeley). Trans. Amer. Nucl. Soc., 11: 392-3(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31906 NEUTRON SPECTRA AS A FUNCTION OF DEPTH IN URANIUM AND IRON-FACED CONCRETE SHIELDING FOR MEDIUM-ENERGY CYCLOTRON BEAMS ON TANTALUM. Wadman III, William W.; Miller, A. Jerry (Univ. of California, Berkeley). Trans. Amer. Nucl. Soc., 11: 402(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31907 RADIATION SHIELDING CONSIDERATIONS OF AN IMPLANTED ^{238}Pu POWER SOURCE FOR THE ARTIFICIAL HEART. Disney, R. K. (Westinghouse Astronuclear Lab., Pittsburgh). Trans. Amer. Nucl. Soc., 11: 92-3(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31908 ATTENUATION OF FAST-NEUTRON BIOLOGICAL DOSE IN NONHYDROGENOUS SHIELDS FOLLOWED BY THIN HYDROGENOUS SHIELDS. Dudziak, Donald J. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc., 11: 197-8 (June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31909 NEUTRON DOSE RATE ATTENUATION BY IRON AND LEAD. Shure, K.; O'Brien, J. A.; Rothberg, D. M. (Westinghouse Electric Corp., West Mifflin, Pa.). Trans. Amer. Nucl. Soc., 11: 198-9(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31910 NUMERICAL TREATMENT OF THE ATTENUATION OF NEUTRONS BY AIR DUCTS IN SHIELDS. Artigas, Ricardo; Hungerford, H. E. (Purdue Univ., Lafayette, Ind.). Trans. Amer. Nucl. Soc., 11: 199-200(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

31911 PASSAGE OF FAST NEUTRONS THROUGH A CHANNEL PARTIALLY PENETRATING THE SHIELD. Bozin, G. M.; Degtyarev, S. F.; Sinitsyn, B. I.; Tarasov, V. V.; Tikhonov, V. K.; Tsypin, S. G. At. Energ. (USSR), 24: 76-8(Jan. 1968). (In Russian).

The flux of fast neutrons with energy $E_n > 0.7$ MeV within a cylindrical channel 10 cm in diameter in paraffin was measured on a ZnS(Ag) scintillation counter. This channel butted onto a LiH shield which was irradiated from the other side by reactor neutrons. The fast neutron flux was measured as a function of the distance R along the channel. The neutrons came from two sources. One source of neutrons penetrated the LiH shield directly, and the other neutron source was due to scattering in the paraffin shield. The calculated neutron fluxes from these two sources agree well with the experimentally observed values. Since the scattered component of the neutron flux decreases as $(R_0/R)^2$, the contribution from the scattered neutrons can be made small by decreasing the ratio of the collimator radius ($R_0 = 10$ cm) to its length. (TTT)

31912 FLUX AND DOSE OF SECONDARY NUCLEONS ON IRRADIATING A PLANE TITANIUM SHIELD WITH 660-MeV PROTONS. Kon'shin, V. A.; Matusevich, E. S.; Regushevskii, V. I. At. Energ. (USSR), 24: 73-5(Jan. 1968). (In Russian).

A narrow proton beam struck a 90 g/cm^2 titanium target at 90°, and the distribution of secondary nucleons at a distance r perpendicular to the proton beam direction was measured from fission reactions on ^{238}U (effective threshold ~ 0.9 MeV), ^{209}Bi (effective threshold ~60 MeV) and Re (effective threshold ~120 MeV). In determining the flux of secondary nucleons within the target it is assumed that the energy distribution of secondary nucleons has the form $dN/dE_n \sim 1/E_n$, and that this distribution does not depend on the point of measurement. The number of secondary nucleons per incident proton at various points in the shield was calculated for $E > 0.9$, $E > 60$, and $E > 120$ MeV. From these data it was possible to calculate an average tissue dose of 5.6×10^{-8} rem/proton · cm^2, and a maximum dose of $13 \pm 2.5 \times 10^{-8}$ rem/proton · cm^2 behind the shield. (TTT)

31913 CALCULATION OF THE PENETRATION OF GAMMA RAYS THROUGH TWO-LAYER SLABS. Shimizu, A. (National Bureau of Standards, Washington, D. C.). Nucl. Sci. Eng., 32: 385-91(1968).

The method of invariant imbedding has been applied to the problem of penetration of gamma rays through two-layer slabs and turned out to be accurate and less time-consuming than the Monte Carlo method. A series of calculations was made for two-layer slabs of water, iron, and lead for plane oblique sources. An approximate formula for synthesizing the buildup factor of a composite slab from those of elementary layers is derived from numerical solutions by modifying the formula originally proposed by Kalos. (auth)

Solid-State Physics

Refer also to abstracts 30852, 31464, 31478, 31595, 31751, 31752, 31778, 31780, 31888, and 32423.

31914 (BNL-50083) PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON SOLID STATE PHYSICS RESEARCH WITH ACCELERATORS, SEPTEMBER 25-28, 1967. Goland, Allen N. (ed.) (Brookhaven National Lab., Upton, N. Y.). 464p. (CONF-670924). Dep. CFSTI.

Separate abstracts were prepared for 30 of the 34 papers included. For abstracts of four papers previously included in NSA, see abstract numbers 21: 39797, 40063 and 22: 15223, 15224. (A.G.W.)

For abstracts of individual papers see: 30427, 31915–31942, and 32479.

31915 (BNL–50083, pp 3-14) WAVE MECHANICAL INTERPRETATION OF CHARGED PARTICLES SCATTERING THROUGH CRYSTALS. DeWames, R. E.; Hall, W. F.; Chadderton, L. T. (North American Aviation, Inc., Thousand Oaks, Calif. Science Center).

The quantum mechanical description of particle propagation in crystals is investigated in appropriate limiting cases. The problem of calculating the intensity pattern outside the crystal due to a source inside the crystal is considered specifically. It is concluded that both Bragg reflection and channeling phenomena can be treated within the framework of the dynamical theory, and a criterion is derived that allows one to judge when the classical mechanical picture is obtained. This criterion is potential-dependent and can never be satisfied by simply requiring the de Broglie wave length to be small or inelastic scattering to be large. (A.G.W.)

31916 (BNL–50083, pp 15-29) DIFFRACTION MODEL OF CHANNELLING OF CHARGED PARTICLES IN CRYSTALS. Howie, A. (Cambridge Univ. (England). Cavendish Lab.).

A diffraction theory of channeling based on the Bloch-wave solutions of the Schroedinger equation is presented and compared with the particle model of channeling. The theory is applied to electrons, protons, and particles emitted from radioactive nuclei in crystals. Channeling in imperfect crystals is considered. It is concluded that the two-beam form of wave theory, which suffices for x rays, neutrons, and electrons, is not adequate for protons and a different approach must be used. (A.G.W.)

31917 (BNL–50083, pp 45-57) EXPERIMENTAL INVESTIGATIONS OF FEEDING-INTO AND ESCAPE-FROM CHANNELS. Appleton, B. R.; Feldman, L. C.; Brown, W. L. (Bell Telephone Labs., Murray Hill, N. J. Rutgers–The State Univ., New Brunswick, N. J.).

Types of measurements made in investigation of feeding into channels of initially unchanneled particles are described briefly. A method of measuring escape from channels of initially channeled particles is presented. The parameter used as a measure of escape is the thickness into the crystal at which one half of the initially channeled particles have escaped. Some data are included on protons in silicon and germanium crystals. (A.G.W.)

31918 (BNL–50083, pp 58-73) DIFFUSION MODEL OF ESCAPE FROM CHANNELS. Feldman, L. C.; Appleton, B. R.; Brown, W. L. (Bell Telephone Labs., Murray Hill, N. J.).

A theory of planar channeling that accounts for the experimentally observed dependence of channeling on crystal thickness is presented. The theory is based on normal multiple Coulomb scattering in an amorphous solid. The contributions of various physical mechanisms that may be involved are considered: discrete atom–ion interactions, thermal vibrations, single electron collisions, and scattering due to lattice defects. Calculations based on the theory agreed well with experimental results for protons in silicon and germanium crystals. (A.G.W.)

31919 (BNL–50083, pp 76-95) USE OF RUTHERFORD SCATTERING TECHNIQUES IN CRYSTAL DEFECT STUDIES. Boegh, Erik (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.).

Lindhard's theory concerning the influence of a crystal lattice on the motion of energetic charged particles is summarized. Experimental application of the theory to study of crystal defects is discussed. Some experiments are described briefly in which scattering of He ions was used to determine the concentration and the sites of impurity atoms in a host lattice and the concentration of displaced crystal atoms. (A.G.W.)

31920 (BNL–50083, pp 106-24) THEORY OF STAR PATTERNS. Thompson, M. W. (Sussex Univ., Brighton (England). School of Mathematical and Physical Sciences).

When a sheet of photographic film was used to record the angular distribution of protons scattered from an initially collimated beam by transmission through a thin crystal, a pattern of light and dark streaks on a diffuse background was obtained. A theoretical model to explain these patterns is developed, beginning with the theory of multiple scattering in gases. It is concluded that the diffuse background is due to a normal group of transmitted protons emerging in a near-Gaussian distribution with energy loss given by standard data tables. The dark streaks are ascribed to protons channeled between atomic planes upon entering the crystal. (A.G.W.)

31921 (BNL–50083, pp 125-41) CHANNELLING OF PROTONS THROUGH THIN CRYSTALS. Dearnaley, G. (Atomic Energy Research Establishment, Harwell (England)); Farmery, B. W. (Sussex Univ., Brighton (England)); Mitchell, I. V.; Nelson, R. S. (Atomic Energy Research Establishment, Harwell (England)); Thompson, M. W. (Sussex Univ., Brighton (England)).

Experiments are reported in which a sheet of photographic film was used to record the angular distribution of protons scattered from an initially collimated beam by transmission through a thin crystal. The resulting "star" patterns are described and interpreted in terms of a theory presented by Thompson at this conference. The relationship between axial and planar channeling is examined. (A.G.W.)

31922 (BNL–50083, pp 144-54) OPTICAL EMISSION FROM ELECTRON-BOMBARDED METAL FILMS. Arakawa, E. T.; Emerson, L. C.; Birkhoff, R. D. (Oak Ridge National Lab., Tenn.).

Experiments in which optical emission from electron-bombarded metal films were used to study energy loss processes are reviewed. The results are compared with other methods of measuring energy loss and with theory. It is concluded that the optical emission method can provide useful information. (A.G.W.)

31923 (BNL–50083, pp 155-66) NONLINEAR INTERACTIONS INVOLVING ENERGETIC ELECTRONS AND PHOTONS IN QUANTUM PLASMAS. Ritchie, R. H.; Wilems, R. E. (Oak Ridge National Lab., Tenn. Tennessee Univ., Knoxville).

The theory and the possibilities for experimental investigation of nonlinear interactions in a plasma system excited by large numbers of energetic electrons or photons are discussed. Interactions in three categories are considered: (1) particle–particle interactions via the plasmon field, (2) three-plasmon interactions, and (3) plasmon–plasmon interactions through imperfections in the plasma system. Some of the processes considered appear to occur with such small probability that they are essentially inaccessible to experimental study in the foreseeable future. Possible approaches to observation of other processes are suggested. (A.G.W.)

31924 (BNL–50083, pp 167-78) SURFACE SCATTERING OF LOW-ENERGY PROTONS AND ALPHA PARTICLES. Edge, R. D.; Lankford, W. F. (South Carolina Univ., Columbia).

Scattering of low-energy protons and alpha particles from surfaces of thick targets is analyzed mathematically in relation to its use in studying surface structure. Scattering from smooth surfaces and from surfaces having various types of irregularities is considered. Results are compared with some experimental results. It is concluded that the mathematical results agree with the experimentally known profiles, but that it is possible to use the mathematical results to determine a profile only to a limited extent. (A.G.W.)

31925 (BNL–50083, pp 204-29) DEFECT PRODUCTION IN METALS BY IRRADIATION AT LOW TEMPERATURES. Sosin, A. (North American Aviation, Inc., Thousand Oaks, Calif. Science Center); Bauer, W. (Atomics International, Canoga Park, Calif.). Contract AT(04-3)-701.

In this survey of defect production in metals by irradiation, emphasis is on low-energy (<3 MeV), low-dose ($<10^{-4}$ fractional defect concentration) electron irradiation experiments and their interpretations. Some studies are included that involve higher-energy bombardment (generally using particles other than electrons) and additional phenomena such as saturation effects and influence of residual defects on damage production. (A.G.W.)

31926 (BNL–50083, pp 244-64) STAGE-III ANNEALING STUDY OF ELECTRON-IRRADIATED PURE ALUMINUM. Lwin, Y. N. (Western Illinois Univ., Macomb); Doyama, M. (Argonne National Lab., Ill.); Koehler, J. S. (Illinois Univ., Urbana).

In an investigation of stage-III annealing, specimens of pure Al were irradiated by 2-MeV electrons at near liquid nitrogen temperature and given various annealing treatments. The stage-III region showed three distinct annealing processes consisting of a main peak C at about −45°K and two smaller peaks A and B on the low-temperature side of the main peak. Stage III C obeyed overall second-order kinetics. An activation energy of 0.62 ± 0.04 eV was obtained, which agrees with neutron-irradiation values obtained by others. It is concluded that stage-III annealing in pure Al occurs by the migration of lattice vacancies. (A.G.W.)

31927 (BNL–50083, pp 265-72) MAGNETIC REMANENCE GROWTH THROUGH VACANCY MOTION IN ELECTRON-IRRADIATED NICKEL–IRON ALLOY. Gordon, D. I.; Sery, R. S. (Naval Ordnance Lab., White Oak, Md.).

Polycrystalline toroidal samples of Supermalloy (79% Ni, 16% Fe, 5% Mo) were irradiated with electrons at around 100°C in a magnetic field. Pronounced magnetic annealing effects were obtained, such as high remanence, loop rectangularity, and maximum permeability. When the radiomagnetic treatment was performed at lower temperatures, 30 to 50°C, the effects did not appear. However, post-irradiation magnetic annealing at 60 to 110°C did bring out the effects. It was also found that it was not necessary to apply the magnetic field during the irradiation in order to obtain the directional ordering by the post-irradiation magnetic annealing in this temperature range. The following defect characteristics were found: activation energy, 1.1 eV; characteristic annealing temperature, 80°C; annealing kinetics, second order. It is concluded that the simple vacancy is the primary defect involved in these experiments. (A.G.W.)

31928 (BNL–50083, pp 291-302) EFFECT OF VARIOUS PRE-IRRADIATION TREATMENTS ON THE PRODUCTION OF POINT DEFECTS IN FCC METALS BY DEUTERON IRRADIATION AND ON THE RECOVERY OF THESE DEFECTS. Jackson, J. J. (Argonne National Lab., Ill.); Herschbach, K. (Douglas Aircraft Co., Santa Monica, Calif.).

In a study of the effects of various pre-irradiation treatments on production of point defects by deuteron irradiation, it was found that large concentrations of quenched-in vacancies increase the defect production rate in Pt, but comparable concentrations of vacancies injected by irradiation or small concentrations of vacancies from quenches do not. Room-temperature deformation increases the defect production rate in Ag, Au, Cu, and Al but not in Pt. Deformation followed by aging at 310°C gives results in Pt similar to those in the other metals. The treatments that do not increase the defect production rate and decrease radiation annealing all increase the amount of recovery in stage I. The amount of recovery in stage III is increased in Ag, Au, and Al by deformation and in Pt by quenching. Consideration of the mechanisms involved leads to the conclusion that the results are well fitted by a model in which two distinct types of interstitials are stable; one is mobile in stage I, the other in stage III. Vacancies are not mobile until stage IV, but this stage is well separated from stage III only in Pt and is not resolved in Al. (A.G.W.)

31929 (BNL–50083, pp 304-13) ANISOTROPY OF DEFECT PRODUCTION IN ELECTRON-IRRADIATED IRON AND SILICON. Banbury, P. C.; Lomer, Jenifer N.; Mitchell, E. W. J. (Reading Univ. (England). J. J. Thomson Physical Lab.).

Measurements of damage rates as a function of electron energy for single crystals of Fe and Si irradiated in different crystallographic directions are described. For Fe a marked difference was seen between the damage rates for samples irradiated in the ⟨111⟩ direction and for those irradiated in the ⟨100⟩ directions. These results are compared with theoretical calculations of Erginsoy on the directional dependence of the displacement energy. In Si the damage rates for the ⟨111⟩, ⟨110⟩, and ⟨100⟩ directions appeared to cross each other repeatedly in the energy range used (0.3 to 2 MeV). Computations are being carried out to determine whether these results can be accounted for by a simple model of the displacement process. (A.G.W.)

31930 (BNL–50083, pp 314-26) STUDY OF ATOMIC DISPLACEMENTS IN ZINC. Maury, F.; Lucasson, A.; Lucasson, P. (Paris Univ., Orsay (France). Laboratoire de Chimie Physique).

The rate of atomic displacement produced in Zn by incident electrons in the energy range 0.4 to 1.7 MeV and in the temperature range 4.9 to 12°K was measured. Comparison of the results with the displacement theory indicates that supplementary data are needed. A threshold energy for atomic displacement was found at 17.5 ± 1.5 eV and at least one other displacement mechanism begins at ~65 eV. (auth)

31931 (BNL–50083, pp 327-34) INFLUENCE OF LOW-ENERGY TRANSFER ON THE DEFECT PRODUCTION IN ELECTRON-IRRADIATED METALS. Dworschak, F.; Lehmann, Chr.; Schuster, H.; Wollenberger, H.; Wurm, J. (Technische Hochschule, Aachen (West Germany). Institut fuer Allgemeine Metallkunde und Metallphysik. Kernforschungsanlage, Juelich (West Germany). Institut fuer Festkorper- und Neutronenphysik).

The rate of damage produced by electron irradiation in metals is discussed in terms of spontaneous recombination and radiation-induced close pair recombination (RIR). Comparison of damage rates calculated according to these two mechanisms with experimental results shows that the influence of RIR upon the damage rate can be neglected in Al and Cu, but in Au the influence of both mechanisms upon the damage rate is approximately equal at the irradiation temperatures used. Spontaneous recombination volumes were determined for Al, Cu, and Au. (A.G.W.)

31932 (BNL–50083, pp 335-47) INTERSTITIALCIES IN METALS. Budin, Claude; Lucasson, Pierre (Paris Univ., Orsay (France). Laboratoire de Chimie Physique).

Known properties of vacancies and interstitial atoms are analyzed with the aim of pointing out the difficulties in their study. A dual experimental method involving quenching and electron irradiation is discussed as a tool for investigating the properties of both vacancies and interstitial atoms and for studying atomic models for Frenkel pair production and annihilation processes. Experimental results obtained by this method are reviewed. When the method is applied to Al, it is found that the models of mobile vacancy-type defects moving in stage III are probably to be discarded. If the mobile defect is a single interstitial, its resistivity is twice that of a single vacancy. If it is a double interstitial, its resistivity is four times that of a single vacancy. (A.G.W.)

31933 (BNL–50083, pp 348-58) INFLUENCE OF VACANCIES AND IMPURITIES ON THE DAMAGE PRODUCTION IN PLATINUM ELECTRON-IRRADIATED AT 90°K. Duesing, G.; Hemmerich, H.; Meissner, D.; Schilling, W. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Festkorper- und Neutronenphysik).

Measurements of the electron damage rate in Pt at 90°K were made over a wide variation of the following parameters: initial impurity concentration, quenched-in vacancy concentration, and radiation-induced defect concentration. The results show that interstitials can freely migrate in stage I. All the interstitials surviving stage I have suffered a reaction with an impurity atom or another interstitial yielding an interstitial configuration immobile at 90°K. These stable interstitials are arranged as transparent clouds around the impurity atoms. No stable interstitials are produced directly by the displacement processes in electron irradiation at 90°K. The following relations exist for the reaction radii of vacancies, r_V, foreign atoms, r_F, and stable interstitials, r_I: $r_V \approx 4 \times r_F$ and $r_V \approx 5 \times r_I$. (auth)

31934 (BNL–50083, pp 359-72) LOW-TEMPERATURE CHARGED-PARTICLE IRRADIATION OF THIN METAL FILMS. Merkle, K. L. (Argonne National Lab., Ill.).

Electrical resistivity measurements have been made on thin metal films after bombardment with heavy particles. Very high defect densities have been achieved in gold by irradiation with 2-MeV α particles and the saturation behavior of the electrical resistivity at 4.2°K has been investigated. The resistivity change that remains in gold after a room-temperature anneal can be ascribed to the black-spot defects as seen by transmission electron microscopy. There seems to exist a lower limit for the cascade energy in gold, below which the defects formed in a cascade recombine upon warm-up to room temperature without leaving a stable cluster behind. (auth)

31935 (BNL–50083, pp 374-88) SPATIAL DISTRIBUTION OF DEFECTS IN CASCADES: BLACK SPOT DEFECTS IN ELECTRON-IRRADIATED COPPER. Sigmund, P.; Scheidler, G. P.; Roth, G. (Kernforschungsanlage, Juelich (West Germany)).

In a theoretical discussion of the spatial distribution of defect cascades, the dimensions of damaged regions as a function of ion or recoil energy, formation of subcascades, vacancy clustering, and the average defect density in cascades are considered. Black-spot defects observed by transmission electron microscopy of Cu foils irradiated with 3-MeV electrons at liquid nitrogen temperature are reported. Concentrations and size distributions of clusters are shown and compared with previous observations on neutron-irradiated Cu. Possible mechanisms for formation of black spots by various types and conditions of bombardment are discussed briefly. (A.G.W.)

31936 (BNL–50083, pp 389-401) COLLAPSE OF VACANCY CASCADES TO DISLOCATION LOOPS. Hesketh, R. V. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.).

The effect of an external stress in initiating the collapse of a vacancy cascade to a dislocation loop is considered. The cascade is assumed to collapse first to a vacancy disc and then to a loop, and the expected deformation rate is established from the size of the disc that is stable against collapse and the cascade size distribution. The observed deformation rate in several metals has the expected magnitude, and its dependence on atomic number and temperature, together with its independence of metallurgical variables, suggest its direct association with vacancy cascades. (auth)

31937 (BNL–50083, pp 402-9) RADIATION DAMAGE AND COLLISION SPECTRA ASSOCIATED WITH CHANNELING OF IODINE IONS IN GOLD. Noggle, T. S.; Barrett, J. H. (Oak Ridge National Lab., Tenn.).

Single-crystal gold films were irradiated by a beam of 51-MeV ^{127}I ions at various orientations with respect to the incident beam. Electron microscope examination of the irradiated specimens shows that the effect of ion irradiation is to introduce spot structures that range in apparent size from several hundred angstroms down to less than 50 Å. Statistics obtained by counting the spot structures indicate the damage rate varies by about a factor of 14 for the orientations used. The experimental results are compared with calculations made using a Monte Carlo computer program written for calculating trajectories of high-speed ions in a lattice and the resulting collision spectra of the host ions. Agreement within the error limits of the two sets of results was found. The computer program also provides the angular distribution of the ions in the emergent beam; comparison of these calculations with experimental results indicates agreement on shape but differences in angular dimensions. (A.G.W.)

31938 (BNL–50083, pp 410-19) COMPARISON OF ELECTRON-INDUCED RADIATION DAMAGE IN KCl AND MgO SINGLE CRYSTALS. Sibley, W. A.; Chen, Y. (Oak Ridge National Lab., Tenn.).

The effects of radiation energy, radiation intensity, temperature, and impurities on defect production by electron irradiation in KCl and MgO were investigated. The strong temperature and radiation intensity dependence of the coloration in KCl indicates that the dominant radiation damage mechanism is photochemical in nature. The results obtained for MgO are consistent with the idea that the primary damage mechanism is that of elastic collisions. It is tentatively concluded that crystal ionicity or crystal bonding may make a significant difference in the mechanism of radiation damage. (A.G.W.)

31939 (BNL–50083, pp 420-7) IONIZATION-INDUCED CONDUCTIVITY IN MgO. van Lint, V. A. J. (General Dynamics Corp., San Diego, Calif. General Atomic Div.).

Single crystals of optical-grade MgO were irradiated by short pulses of 30-MeV electrons over a wide range of temperature and ionization intensities. The results and some of their implications are discussed with respect to the following: dependence of delayed conductivity on temperature for low doses, dose dependence of prompt and delayed charge, dependence of prompt charge on accumulated dose, and dependence of delayed current on accumulated dose. A model for MgO involving three trapping levels is presented. (A.G.W.)

31940 (BNL–50083, pp 430-41) EXCESS-CARRIER EFFECTS IN SEMICONDUCTORS. Flanagan, T. M.; van Lint, V. A. J. (General Dynamics Corp., San Diego, Calif. General Atomic Div.).

The drift mobility of a localized concentration of excess carriers and the conductivity and Hall coefficient in the presence of excess carriers uniformly distributed through a sample are considered. The excess carriers were generated by pulses of 30-MeV electrons. Experimental results on Ge and Si are reported briefly. A theory to account for the observations is proposed, in which the carrier and Hall mobilities are regarded as experimental parameters and in which no assumptions about the details of the band structure or about carrier relaxation times are made. (A.G.W.)

31941 (BNL–50083, pp 442-53) APPLICATION OF THE MICROWAVE REFLECTION TECHNIQUE TO THE STUDY OF RADIATION DAMAGE IN HIGH-PURITY SILICON. Naber, J. A. (General Dynamics Corp., San Diego, Calif. General Atomic Div.).

A microwave-reflection technique for measurement of electric conductivity of Si at cryogenic temperatures is described. The technique was used to study the defects introduced in high-purity n- and p-type Si by 30-MeV electron irradiation. The excess minority carrier lifetime was the parameter investigated as a function of temperature, irradiation fluence, and injection level. The results agree with the Shockley–Read carrier recombination theory and with the theories of Lax on the temperature dependence of the cross section for neutral and attractive recombination centers. (A.G.W.)

31942 (BNL–50083, pp 454-61) STUDY OF HIGH-ENERGY-ELECTRON RADIATION-INDUCED DEFECTS IN SILICON USING MICROWAVE RESONANCE AND GALVANOMAGNETIC TECHNIQUES. Wikner, E. G.; Horiye, H. (General Dynamics Corp., San Diego, Calif. General Atomic Div.).

Galvanomagnetic and ESR techniques were used to study the effects of irradiation by 5- to 30-MeV electrons on phosphorus-doped silicon. The ESR work concentrated on the B1 center (vacancy–oxygen), the G7 center (divacancy), and the G8 center (vacancy–phosphorus). The galvanomagnetic experiments consisted of measurements of the conductivity, number of carriers, and the Hall mobility. It was found that a substantial number of B1 and G8 centers are produced at 80°K. Since these centers are formed by the migration of the vacancy to the impurity atom, the vacancy must be mobile at or below 80°K in n-type Si. It was also determined that the energy level associated with the divacancy must lie close to that of the vacancy–phosphorus center. It was observed that the annealing between 80 and 300°K is associated with deep-lying levels in the band gap. Between 300 and 400°K the annealing may well be a function of the oxygen content. (A.G.W.)

31943 (FOA–4–4352-23) LATTICE SYMMETRY CORRECTIONS TO ENERGY-BANDS FROM A SPHERICAL MODEL. I. THEORY. Arbman, G. (Forsvarets Forsknigsanstalt, Stockholm (Sweden)). Apr. 1968. 37p. Dep.

A procedure is presented to impose symmetry corrections on the energy bands obtained from a spherical version of the cellular method. The mathematical basis is an earlier described variational principle. Wave functions obtained from the spherical model are utilized in the variational functional. Particular attention is paid to simple cubic, face-centered-cubic, and body-centered-cubic structures. (auth) (Sweden)

31944 (IN–1129) PHONON DISPERSION RELATION OF BERYLLIUM OXIDE. Ostheller, G. L.; Schmunk, R. E.; Kearney, R. J. (Idaho Nuclear Corp., Idaho Falls). May 1968. Contract AT(10-1)-1230. 30p. Dep. CFSTI.

The phonon dispersion relation measurements for BeO have been extended by neutron inelastic scattering, using the MTR triple-axis spectrometer. New data include a transverse acoustic branch and an optical branch with wave propagation in the $[01\bar{1}0]$ direction and in addition the transverse acoustic, longitudinal acoustic and a transverse optic branch, all with wave propagation in the [0001] direction. The two optical branches observed are degenerate at the center of the Brillouin zone with a frequency $\omega = 6.21 \pm 0.11 \times 10^{13}$ rad sec^{-1}. This frequency is in fair agreement with the optical data of Loh which gives $\omega = 6.41 \times 10^{13}$ rad sec^{-1} for the same mode. From the neutron-scattering data of this experiment and the optical data of Loh it appears that the low-lying optical branches reported previously by Brugger et al., are not single-phonon data, but are the result of multiphonon processes. Comparison is made between the measured branches of the dispersion relation and the results of preliminary lattice dynamics model calculations by Young and by Solbrig. (auth)

31945 (TID–24503) F CENTER FORMATION AT 78°K IN KBr DURING EXPOSURE TO MONOCHROMATIC X-RAY ENERGIES AROUND THE BROMINE K EDGE. Cruz Vidal, Baltasar Augusto (Harvard Univ., Cambridge, Mass.). May 1967. 124p. Dep. CFSTI.

Thesis.

In KBr (obtained from the Harshaw Chemical Company) irradiated at 78°K the rate of formation of F centers per unit energy retained in the crystal was found to be the same whether 13.4- or 14.1-keV was the incident photon energy (the K edge of bromine is at 13.5 keV). In other words, at either incident photon energy the energy expenditure per F center formed was 1.21×10^3 eV ± 4.4%. This result indicates that K-shell ionization in bromine does not affect the mechanism of formation of F centers in KBr. However, a large background of multiply ionized atoms is expected, whether the incident photon energy is 13.4 or 14.1 keV. Each of these atoms becomes multiply ionized after losing an electron in the L shell. Thus, in a bromide the equality of the rate of formation of F centers above and below the K edge is not sufficient evidence to conclude that a Varley mechanism of F-center formation is not operative. Each of the monochromatic beams was the fluorescent output of RbCl filtered with a thin layer of NaBr or of $Sr(NO_3)_2$ filtered with RbCl. The output of a Machlett x-Ray Tube operated at 45 kvp was used to excite the fluorescence. The current in the tube was regulated to achieve the same energy flux on the sample regardless of the incident photon energy. An air ionization chamber was calibrated with a calorimeter and was used to measure the flux. The half-width of each monochromatic beam was 330 eV. Measurements of the energy expenditure required to form one F center follow: for KCl (Harshaw Chemical Company) irradiated at 78°K, 6.9×10^2 eV ± 4.2%; for KBr irradiated at 300°K, 4.8×10^3 eV ± 5.7%; for RbBr (Isomet Corporation) at 78°K, 1.2×10^3 eV ± 17%; and for RbBr at 300°K, 1.3×10^3 eV ± 30%. (auth)

31946 **THERMAL DIFFUSIVITY OF URANIUM BY LASER PULSE METHOD FROM 20^0 TO 850^{0}C. Nasu, Shoichi; Fukushima, Susumu; Ohmichi, Toshihiko; Kikuchi, Takeo (Japan Atomic Energy Research Inst., Ibaraki). Jap. J. Appl. Phys., 7: 682(June 1968).**

The thermal diffusivity over the temperature range of αU is between 0.105 and 0.085 cm^2/sec. Two minima in the thermal diffusivity–temperature curve at about 630 and 750°C may correspond to the transition temperature from α to β phase and from β to γ phase. Values for the heat capacity and the thermal conductivity of U at room temperature of 2.6×10^{-2} cal/g°C and 5.2×10^{-2} cal/cm sec °C were obtained. (A.G.W.)

31947 THERMAL EXPANSION OF ALPHA URANIUM BELOW 10°K. Andres, K. (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., 170: 614-17(June 15, 1968).

The thermal-expansion coefficient of α U (orthorhombic) remains negative in the a and b directions and positive in the c direction below 43°K, the reported temperature for a suggested phase transition. Below 5°K, the temperature dependence of the three expansion coefficients can be described by $\alpha_1 = (1/a)\partial a/\partial T = -21 \times 10^{-8}T - 27 \times 10^{-10}T^3$, $\alpha_2 = (1/b)\partial b/\partial T = -3.7 \times 10^{-8}T - 3.1 \times 10^{-10}T^3$, and $\alpha_3 = (1/c)\partial c/\partial T = +5.0 \times 10^{-8}T + 3.2 \times 10^{-10}T^3$. It is shown that these results are thermodynamically consistent with the pressure dependence of the specific heat observed by Ho et al. Hysteretic behavior is observed in that the linear dimension of the crystal at 0°K depends on the speed of cooling in the range 25 to 15°K. (auth)

31948 DELAYED LUMINESCENCE OF THE M CENTER IN F-TO-M CONVERSION IN NaF. Andrews, R. A.; Kim, Y. W. (Wayne State Univ., Detroit). Contract AT(11-1)-1054. Phys. Rev., 170: 793-9(June 15, 1968).

A delayed luminescence has been observed in x-irradiated NaF samples after bleaching with F light near room temperature. The delayed luminescence (DL) is attributed to the latent formation of M centers in their excited state and their subsequent luminescence. An analysis of the decay of this DL indicates that there are two types of migrating centers involved in F-to-M conversion, corresponding to two competing optical bleaching processes. It is proposed that these two migrating centers are $(\alpha,\tilde{\alpha})$ centers (vacancy pairs) and α centers (anion vacancies). The activation energies for individual migrating centers are found from the temperature dependence of the exponential decay of the DL to be $E_1 = 0.75 \pm 0.02$ eV and $E_2 = 0.77 \pm 0.08$ eV. The temperature dependence of the time constant for the growth of the DL when the F light is turned on indicates that the activation energy for F-to-M conversion is $E_g = 0.62 \pm 0.02$ eV. (auth)

31949 INFLUENCE OF PLASTIC DEFORMATION AND OF SUBSTITUTIONAL GOLD ON DEFECT PRODUCTION AND RECOVERY IN PLATINUM. Jackson, J. J. (Argonne National Lab., Ill.); Herschbach, K. Phys. Rev., 170: 618-30(June 15, 1968).

Both the production of defects in Pt by deuteron irradiation at 6°K and the subsequent thermally activated recovery of these defects are perturbed when Pt is deformed or alloyed before irradiation. The atomic rearrangements that occur in various recovery substages are known with perhaps less ambiguity in Pt than in any other metal. This knowledge is used to analyze in detail the interactions between the defects injected before the irradiation and the atoms displaced during the irradiation that produce these perturbations. (auth)

31950 ELASTIC MODULI AND PHASE TRANSITION IN URANIUM AT T < 43°K. Fisher, E. S.; Dever, D. (Argonne National Lab., Ill.). Phys. Rev., 170: 607-13(June 15, 1968).

The elastic moduli of single crystals of αU have been measured with some success at temperatures between 2 and 43°K. Minima in the shear moduli c_{55} and c_{66} are observed at 18°K on cooling and at 22.5°K on heating with high acoustic attenuation at T < 43°K. Hysteresis is also observed in the c_{11} modulus at 10.5°K < T < 35°K. It is concluded that an $\alpha_0 \rightleftharpoons \alpha$ structural phase change occurs at some temperature between 35 and 43°K and that the two phases are very similar in structure, thus explaining the absence of a heat-capacity anomaly and the coexistence of α_0 and α over a wide temperature range. It is proposed that the filamentary superconductivity at T < 2°K and the excess electrical resistance at 4°K are produced by the α phase retained by fast cooling. (auth)

31951 NONEXPONENTIAL SPIN–LATTICE RELAXATION OF PROTONS IN SOLID CH_3CN AND SOLID SOLUTIONS OF CH_3CN IN CD_3CN. Baud, Michael F.; Hubbard, Paul S. (Univ. of North Carolina, Chapel Hill). Phys. Rev., 170: 384-90(June 10, 1968).

The proton spin–lattice relaxation in solid CH_3CN, and in 1 : 6 and 1 : 10 solid solutions of CH_3CN in CD_3CN, has been measured by pulsed NMR techniques at a frequency of 30.0 MHz, for temperatures between 79.5 and 173°K. The relaxation is nonexponential at the higher temperatures, and exponential only at the lowest temperature. The experimental results for 1 : 6 solutions are compared with the relaxation previously predicted by a calculation based on the assumptions that (1) the relaxation is due to intramolecular dipole–dipole interactions between protons, which are time-dependent because of hindered rotations of the methyl groups, (2) the axes of hindered rotation are randomly oriented, and (3) the correlation time for reorientation is the same for all methyl groups at the same temperature. The distinctly nonexponential relaxation predicted by the theory is due to the inclusion of the effects of the cross correlations of the intramolecular dipole–dipole interactions. The agreement between the experimental results and the calculations is fairly good, the discrepancy being attributable to the effects of other relaxation mechanisms, such as intermolecular dipole–dipole interactions. The results provide the first experimental evidence of nonexponential spin–lattice relaxation produced by the effects of cross correlations of dipole–dipole interactions. (auth)

31952 RESPONSE OF NaI(Tl) TO ENERGETIC HEAVY IONS. Katz, Robert; Kobetich, E. J. (Univ. of Nebraska, Lincoln). Phys. Rev., 170: 397-400(June 10, 1968).

Experimental values of the relative heights of scintillation pulses generated in NaI(Tl) crystals, by heavy ions (Z > 5) of energy 1 to 10 MeV/amu, agree well with computed relative cross sections for photon production, from a theory based on the assumption of a one-hit response to the spatially distributed dose of ionization energy, and a characteristic dose of 4×10^7 erg/cm^3 for this material. Discrepancies between theory and experiment for He bombardments arise from the theoretical neglect of the nonlinear dose variation over the sensitive volume surrounding each Tl atom. Similar discrepancies arising from the neglect of molecular volume occur in the theory of heavy-ion inactivation of dry enzymes and viruses, which forms the basis for the present work. (auth)

31953 FORMATION OF ETCHABLE TRACKS IN DIELECTRICS. Katz, Robert; Kobetich, E. J. (Univ. of Nebraska, Lincoln). Phys. Rev., 170: 401-5(June 10, 1968).

It is proposed that etchable damage is produced in dielectrics by energetic charged particles when a critical dosage of ionization energy is deposited at a critical distance from the ion's path by secondary electrons. Within the critical cylinder, molecular fragments more soluble than the parent molecule are formed. The radius of the critical cylinder is taken to be approximately 20 Å, as is appropriate to the passage of the etchant along the track and the diffusion of reaction products back to the surface. At the critical radius the dosage approximates doses producing bulk damage under γ irradiation. The proposed criterion predicts the formation or nonformation of etchable tracks in Lexan polycarbonate, cellulose, nitrate, and mica, in agreement with published data. The calculations have been extended to magnetic monopoles to establish criteria for their detection in dielectric track detectors. (auth)

31954 KNIGHT SHIFTS OF ^{13}C IN THE CARBIDES OF URANIUM AND THORIUM. Lewis, W. Burton; Rabideau, Sherman W.; Krikorian, N. G.; Witteman, W. G. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 170: 455-62(June 10, 1968). (LA-DC-9122).

The ^{13}C nuclear magnetic resonance has been observed in the unenriched carbides of thorium, and uranium ThC, ThC_2, UC, U_2C_3, and UC_2. In contrast to nearly all nonmagnetic metals and semimetallic compounds, the Knight shift in the semimetallic thorium carbides is negative. On the other hand, the Knight shifts in all of the uranium carbides are positive, which is consistent with the ^{31}P shift in UP and PrP. The ^{13}C Knight shift in all of the carbides except U_2C_3 was temperature-independent. On the basis of magnetic susceptibility evidence, it is found that the uranium carbides are similar to other semimetallic uranium compounds in that their magnetic properties are best explained at higher temperatures with a localized f-electron model with large crystal-field splitting. The ^{13}C Knight shift in the uranium carbides is interpreted in terms of an effective hyperfine field resulting from the presence of two 5f electrons in UC and UC_2 and three in U_2C_3. Only the lowest crystal-field level of the $^3H_4$ configuration (the nonmagnetic level Γ_1 in the case of UC) is appreciably populated in UC and UC_2. A comparison of hyperfine fields in a variety of lanthanide and actinide compounds suggests that the fields in semimetallic compounds and insulators have similar origins and that the differences are associated largely with structure, covalency, and overlap, and not with the presence or absence of conduction electrons. (auth)

31955 SUBLATTICE MAGNETIZATION OF SEVERAL RARE-EARTH IRON GARNETS. Myers, Samuel M.; Gonano, Roland; Meyer, Horst (Duke Univ., Durham, N. C.). Phys. Rev., 170: 513-19(June 10, 1968).

Pulse measurements of the NMR frequency of ^{57}Fe in the iron garnets (IG) of Gd, Tm, and Lu are reported as a function of temperature up to about 380°K. The effect of rf pulse energy on observed line shape is briefly discussed. It is shown that for sufficiently high rf energy, the observed line shape is due to resonance within the domains, as distinct from resonance in domain walls. Using domain resonance data and total magnetization measurements, the magnetizations for the a, d, and c sublattices are computed. For GdIG, the results are analyzed in terms of spin-wave theory and a molecular-field approximation. Spin-wave analysis yields a value of the dispersion parameter $D = 8.2\ cm^{-1}$. If the magnetization data of Anderson are used and J_{ca} is taken to be zero, a molecular-field analysis of the c sublattice magnetization gives $J_{cd} = -2.86\ cm^{-1}$ and $J_{cc} = -0.03\ cm^{-1}$. The influence of the Gd^{+3} magnetization on the iron sublattices is demonstrated and discussed. The sublattice magnetization of TmIG is also presented and discussed, as well as new data on LuIG between 180 and 320°K. As was the case for YIG, the total LuIG magnetization calculated from NMR data is in excellent agreement with the measurements of Geller et al. ^{57}Fe resonances at 4.2°K are reported for ErIG and DyIG, and an estimate of the dependence of hyperfine coupling on molar volume is made. (auth)

31956 SUBLATTICE MAGNETIZATION IN EUROPIUM IRON GARNET. Myers, S. M. (Duke Univ., Durham, N. C.); Remeika, J. P.; Meyer, Horst. Phys. Rev., 170: 520-3(June 10, 1968).

The NMR frequencies of ^{57}Fe were measured in europium iron garnet between 4.2 and 370°K. From these data and from measurements of the total magnetization, the magnetizations of the a, d, and c sublattices are calculated. A spin-wave analysis at low temperatures yields $D = 28.4 \pm 0.8\ cm^{-1}$, as compared to $D = 30.0 \pm 0.6\ cm^{-1}$ for yttrium iron garnet. The temperature dependence of the exchange field acting on Eu^{+3} confirms that interactions between the a and c sublattices are negligible, and shows that $J_{ac}/J_{dc} < 0.03$. Using, in addition, the information from Mössbauer studies on europium garnets, one calculates $J_{cd} = -2.74\ cm^{-1}$ and $J'_{cd} = -0.19\ cm^{-1}$, where these parameters represent respectively the exchange with the nearest and next-nearest neighbors on the d sublattice. (auth)

31957 ULTRASONIC ATTENUATION AND ELASTIC CONSTANTS FOR URANIUM DIOXIDE. Brandt, Ogden G.; Walker, Charles T. (Northwestern Univ., Evanston, Ill.). Phys. Rev., 170: 528-41(June 10, 1968).

Elastic-constant measurements for c_{11}, $c_{11}-c_{12}$, and c_{44} have been made over the temperature range of 4.2 to 300°K. Anomalies are found in all three elastic constants near the Néel point, but particularly large anomalies are seen for c_{44}. Ultrasonic attenuation measurements at 50 MHz for all three elastic constants are also given as a function of temperature. Both c_{11} and $c_{11}-c_{12}$ have small attenuations confined to the immediate vicinity of T_N. There is a very large attenuation associated with c_{44}, and the attenuation extends over a broad temperature range. c_{44} is seen to vary as T^{-1} in the paramagnetic region. This behavior has led to an analysis of c_{44} in the paramagnetic region, in terms of a coupling between elastic strains and the triplet ground state for the U^{4+} ion. The magnitude of the strain coupling parameter is deduced from the data to be 722 cm^{-1} per unit strain. Dynamical Jahn–Teller interactions are discussed as the source of this coupling. The attenuation for c_{44} is analyzed in terms of relaxation theory and it is shown that the relaxation time deduced varies exponentially with temperature, with relaxation times of the order of 10^{-11} sec. The c_{11}, the $c_{11}-c_{12}$, and part of the c_{44} data are discussed in relation to an Ising-model calculation of Garland and co-workers. Only qualitative statements can be made, but it seems reasonable that the c_{44} data reflect the angular dependence of the exchange energy, particularly of the U–O–U bond. The c_{11} and $c_{11}-c_{12}$ attenuation data below T_N are qualitatively in agreement with the Landau-Khalatnikov theory of relaxation by critical scattering from long-range order fluctuations. A relaxation time of 5×10^{-10} sec is estimated for relaxation due to long-range order fluctuations below T_N. There are no such fluctuations above T_N. (auth)

31958 TEMPERATURE DEPENDENCE OF THE MAGNETIZATION OF AN AMORPHOUS FERROMAGNET. Tsuei, C. C.; Longworth, G.; Lin, S. C. H. (California Inst. of Tech., Pasadena). Contracts AT(94-3)-63; AT(04-3)-221. Phys. Rev., 170: 603-6 (June 10, 1968).

An amorphous alloy $Fe_{80}P_{12.5}C_{7.5}$ obtained by rapid quenching from the liquid state has previously been shown to be ferromagnetic. The results of bulk magnetization and magnetic hyperfine field measurements as a function of temperature are reported. The Mössbauer spectrum of the alloy consists of broadened lines indicating a nonunique magnetic hyperfine field at the ^{57}Fe nuclei. The average hyperfine field has the value 282 ± 1 kG at 4.2°K and is shown to vary with temperature essentially according to a Brillouin function with a Curie temperature of (586 ± 2) °K. Measurements of the bulk magnetization as a function of temperature agree with the hyperfine field variation and yield a value for the magnetic moment per iron atom of $(2.10 \pm 0.01)\ \mu_B$. A simple model of a disordered alloy with a spread in interatomic spacing is used to predict the shape of the Mössbauer spectra and also to explain the reduction in magnetic moment per iron atom compared with pure iron. Although the magnetic moment per iron atom in this amorphous alloy is only slightly smaller than that of pure iron, the Curie temperature is greatly reduced, possibly because of the lack of strict periodicity in the atomic arrangement. (auth)

31959 RESONANCE ABSORPTION OF 23.8 keV GAMMA-QUANTA BY ^{119}Sn IMPURITY NUCLEI IN FERRITE SPINELS WITHIN A TEMPERATURE RANGE ABOVE THE CURIE POINT. Gruzin, P. L.; Shlokov, G. N.; Alekseev, L. A. (Moscow Inst. of Engineering Physics). Dokl. Akad. Nauk SSSR, 176: 362-4 (Sept. 11, 1967). (In Russian).

The probability of resonance absorption (f′) of 23.8-keV gamma quanta by ^{119}Sn was determined in MgMn, MnZn, and FeMn ferrites. The ferrite samples contained 2 to 5% of 86.9% enriched ^{119}Sn. The measurements were carried out above the Curie temperature to avoid fine splitting of the nuclear level. The value of f′ was significant even at a high temperature of 900°C. It was shown that the probability of resonance absorption f′ on impurity ^{119}Sn nuclei in various ferrites at a fixed temperature above the Curie temperature T_c is greater, the higher the Curie temperature T_c of the ferrite. Ferrites with values of T_c close to each other have the same value of f′. In a mixed MnZn ferrite, the value of f′ decreased with increasing Zn content of the ferrite. On plotting values of f′ as a function of T/T_c, a straight line was obtained. Thus the Moessbauer effect can be used to find ferrites with a higher temperature stability. (TTT)

31960 ^{125}Te MOESSBAUER EFFECT STUDY O RADIATION EFFECTS AND MAGNETIC HYPERFINE INTERACTIONS IN TELLURIUM COMPOUNDS. Ullrich, John Frederick. Ann Arbor, Mich., Univ. of Michigan, 1967. 177p.

Thesis.

The effects of neutron capture induced defects on Moessbauer hyperfine spectra in ^{125}Te were determined experimentally. Thermal neutron capture in ^{124}Te is used to simultaneously produce the Moessbauer isomeric state parent ^{125m}Te and to introduce the parent nucleus as a defect in the lattice. The displacement mechanism is the recoil of the nucleus due to the emission of 6.4 MeV of prompt gamma rays following the neutron capture. Since the Moessbauer hyperfine spectrum is sensitive to the immediate electronic environment of the emitting nucleus, the Moessbauer spectrum should provide information on characteristic defect environments. The effects were experimentally investigated by irradiating tellurium compounds enriched in ^{124}Te with thermal neutrons. The Moessbauer resonance absorption spectrum was then measured against a single line absorber. This spectrum should be characteristic of the lattice with the atoms displaced from the normal lattice sites. The spectrum characteristic of the ideal lattice was obtained using the same sources following heat treatment to restore the atoms to their normal lattice environment. The measurements were performed using sources of PbTe, Te metal, and TeO_2. For all three compounds, there were no statistically significant differences in the pre-anneal and post-anneal Moessbauer hyperfine spectra. Differences of several percent in the resonance intensity are within the experimental accuracy of the measurement. The lack of any significant changes in the hyperfine spectra may be due to either: (a) a recoil energy too low to produce displacements; (b) replacement collisions; (c) defect annealing; or (d) insignificant changes in hyperfine interaction parameters. The purpose of the second part of this study was to experimentally investigate magnetic hyperfine spectra in magnetic compounds of tellurium. The diamagnetic Te^{2-} ion with paired 5s and 5p electrons would not normally be expected to give rise to a magnetic hyperfine field at the Te nucleus. However, in compounds with the transition metals, the magnetically coupled transition metal ions can act to spin polarize the paired electron shells of the tellurium ion. The unpaired tellurium 5s electron spins will have a net spin density at the tellurium nucleus and will give rise to a magnetic hyperfine field through the Fermi contact interaction. Moessbauer resonance absorption measurements in the ferromagnetic spinel $CuCr_2Te_4$ show a partially resolved magnetic hyperfine pattern. From the least squares curve fitting to the data, the magnetic moment for the $\frac{3}{2}$ + excited state of ^{125}Te was determined to be $\mu_e = +0.74 \pm 0.07$ nm. The internal hyperfine field was measured as $H_{eff} = 148 \pm 5$ kgauss. The unpairing of the tellurium 5s electrons in the spinel probably arises through either covalent mixing of the 5s electrons with the chromium 3d electrons or exchange polarization of the 5s electrons by the chromium 3d electrons. Moessbauer resonance absorption measurements in antiferromagnetic MnTe and ferromagnetic CrTe show only broadened lines. The broadening in MnTe is presumably due to unresolved quadrupole splitting, whereas the broadening in CrTe is probably unresolved magnetic hyperfine splitting. (Diss. Abstr.)

31961 MEASUREMENTS OF NUCLEAR SPIN RELAXATION TIME T_1 AND T_2 IN PARAMAGNETIC SOLUTIONS. Kul'beda, V. E. (Moscow Radiotechnical Inst.). Prib. Tekh. Eksp., No. 6, 106-8(Nov.-Dec. 1967). (In Russian).

Processes governing nuclear magnetic resonance amplitudes in pulse-saturated EPR spectra in paramagnetic solutions with the Overhauser effect present were studied. Nuclear spin relaxation times $T_1 \gg T_2$ in paramagnetic solutions were measured by correlating the pulse modulation of EPR saturation with magnetic field modulation. (tr-auth)

31962 REINTERPRETATION OF DATA ON MULTIPLE CHARGE STATES OF Fe IN CoO. Schroeer, D.; Triftshaeuser, W. (Univ. of North Carolina, Chapel Hill). Phys. Rev. Lett., 20: 1242-5(May 27, 1968).

It is suggested that the samples studied in recent Moessbauer experiments on CoO doped with ^{57}Co included microcrystals as well as polycrystalline bulk. This interpretation resolves the conflict concerning the temperature reversibility of the interconversion between the observed ferrous and ferric valence states, and is consistent with the cation-vacancy stabilization model. (auth)

31963 NMR QUADRUPOLE STRUCTURES IN DYNAMIC NUCLEAR POLARIZATION WITH INHOMOGENEOUSLY BROADENED ESR LINE. Lee, S. (Saint Louis Univ.). Phys. Lett., 26A: 572-3(Apr. 22, 1968).

An investigation has been made of the behavior of NMR quadrupole structures under dynamic nuclear polarization (the solid state effect) produced by applying a microwave pumping power at the center of an inhomogeneously broadened ESR line. (auth)

31964 MAGNETIC STRUCTURE OF DyC_2. Atoji, Masao (Argonne National Lab., Ill.). J. Chem. Phys., 48: 3384-8 (Apr. 15, 1968).

The compound, DyC_2, having the tetragonal body-centered CaC_2-type structure has been shown by neutron diffraction to exhibit the magnetic spin alignment of a linear, transverse wave mode below the Néel temperature of 59°K. This static moment wave is propagating along the a axis and is polarized in the c-axis direction. The root-mean-square and maximum saturation moments per Dy are 8.37 and 11.8 Bohr magnetons, respectively, the latter being considerably larger than the ordered moment of the free Dy^{3+} ion, 10.0 μ_B. The wavelength of the moment wave is about 1.3 times the a spacing and is practically temperature independent. An additional, coexisting spin alignment with a very small moment appears to take place below 31°K. The crystallographic parameters in the range 300°–5°K are also presented. The thermal-neutron coherent scattering amplitude of Dy is established as $(1.70 \pm 0.01) \times 10^{-12}$ cm. (auth)

31965 ESR STUDIES OF RADIATION-INDUCED NIOBIUM CENTERS IN Nb_2O_5–Na_2O–SiO_2 GLASSES. Kim, Y. M.; Reardon, D. E.; Bray, P. J. (Brown Univ., Providence). Contract AT(30-1)-2024. J. Chem. Phys., 48: 3396-3402(Apr. 15, 1968).

Electron spin resonance (ESR) studies have been made of gamma-irradiated $Nb_2O_5-Na_2O-SiO_2$ glasses. The samples received a gamma-irradiation dose of 2×10^7 R at liquid-nitrogen temperature, and were investigated at that temperature. A broad spectrum which is characterized by an axially symmetric g tensor and hyperfine interaction with the $^{93}Nb(I = {}^9/_2)$ nucleus, is identified as due to an Nb^{4+} center formed in a niobium–oxygen unit. A separate, narrow spectrum located in approximately the center of the broad spectrum can be separated into three distinct spectra: a sharp central spectrum, an asymmetric spectrum on the high-field side, a 10-line spectrum. The sharp central and asymmetric spectra are identified as due to two different centers formed in silicon–oxygen units. A hole in an NbO_6 unit is proposed as a model for the 10-line spectrum. (auth)

31966 NMR STUDY OF FERROELECTRIC $LiNbO_3$ AND $LiTaO_3$. II. Peterson, G. E.; Bridenbaugh, P. M. (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Chem. Phys., 48: 3402-6(Apr. 15, 1968).

A study of the ^{7}Li nuclear magnetic resonance in a $LiTaO_3$ single crystal is made and the electric field gradient at the lithium site is determined. Electric-field-gradient calculations indicate that the net charge on the tantalum is +1.21 while that on the oxygen is −0.74. This shows that the tantalate ion is predominantly covalently bonded. The ^{93}Nb resonance in a $LiNbO_3$ single crystal is also studied and the quadrupole coupling constant is found to be 22.02 Mc/sec. (auth)

31967 SCATTERING OF SUBTHERMAL NEUTRONS BY DEFECTS IN NEUTRON-IRRADIATED ALUMINUM. Niklaus, J.-P.; Schmatz, W.; Simson, R.; Wenzl, H. (Technische Hochschule, Munich). Z. Angew. Phys., 24: 313-17(May 1968). (In German).

After neutron irradiation of aluminum at 4°K the diffuse scattering of subthermal neutrons was measured at 20°K. At a defect-induced resistivity change of 704 nΩ-cm the maximum differential scattering cross section per unit solid angle amounts to $d\sigma/d\Omega = 0.1$ m barn/sterad. The comparison with the corresponding lattice parameter change leads to values for the volume change by the distortion fields for vacancies ν_L and interstitials ν_i and for the resistivity change ρ per Frenkel defect/atom; $\nu_i = 1.4$, $\nu_L = -0.2$ atomic volumes, $\rho = 300$ μΩcm. (auth)

31968 MAGNETIC STRUCTURE STUDY OF Y_6Mn_{23} WITH POLARIZED NEUTRONS. Dworak, A.; Kirchmayr, H. R.; Rauch, H. (Oesterreichische Hochschule, Vienna. Technische Hochschule, Vienna). Z. Angew. Phys., 24: 318-21(May 1968). (In German).

The magnetic structure of Y_6Mn_{23} at room temperature was investigated by means of polarized neutrons. The measurements were done with a compact sample and in a magnetic field of 18.6 kOe. The results indicate a weak ferrimagnetic coupling, where the magnetic moments of the Mn ions are different. (auth)

31969 EXOELECTRON EMISSION FROM BaF_2 AND SrF_2 INDUCED BY X RAYS. Sujak, B. (Wroclaw Univ.); Gasior, S. Acta Phys. Pol., 33: 231-8(Feb. 1968).

Thermo- and photostimulated exoelectron emission from polycrystalline BaF_2 and SrF_2 was investigated with the use of a flow point counter operating in atmospheric air. The curve of thermostimulated emission decay was found to have three maxima: for BaF_2, in the vicinity of the temperatures T_{m_1} = 398°K, T_{m_2} = 453°K, and T_{m_3} = 599°K; and for SrF_2, in the vicinity of the temperatures T_{m_1} = 431°K, T_{m_2} = 526°K, and T_{m_3} = 656°K. In the case of the two materials tested the dependence of the total number of pulses recorded (electrons) N upon the x-ray dose within the range from D = 2 to D = 100 R was found to be linear. Moreover, the integrally recorded emissivity was distinctly seen to be affected by the illumination and heating rate of the samples. The influence of aging samples after x irradiation on N has also been investigated in both the case of photostimulation and thermostimulation of exoelectron emission. It was found that in the case of photostimulation the curve $N = f(t_{age})$ reaches maximum after three days for BaF_2 and after 13 days for SrF_2. In the case of thermostimulation the curves $N = f(t_{age})$ become saturated after an aging time at which a maximum appears for photostimulation. (auth)

31970 ESR OF A [111] DEFECT IN X-RAYED LiF. Chu, Y. Hou; Mieher, Robert Lee (Purdue Univ., Lafayette, Ind.). Phys. Rev. Lett., 20: 1289-92(June 3, 1968).

A new defect center that is believed to be the equivalent of the interstitial halide atom is observed in x irradiated pure LiF. It has the form of a negatively charged diatomic halide molecule situated on a single halide site and orientated along a [111] axis. The ESR constants are $g_x = g_y = 2.0105$, $g_z = 2.0017$, $T_x = T_y$ = 19.0 G, and T_z = 1005.9 G. (auth)

31971 LOCATION OF ELECTRON AND HOLE CARRIERS IN GRAPHITE FROM LASER MAGNETOREFLECTION DATA. Schroeder, P. R.; Dresselhaus, M. S.; Javan, A. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. Lett., 20: 1292-5(June 3, 1968).

Magnetoreflection experiments have been carried out on pyrolytic graphite using circularly polarized radiation from an infrared gas laser source. From a preliminary analysis of the data, it was found that the carriers at point K in the Brillouin zone are electrons rather than holes. Additional support for this conclusion is obtained from a reexamination of the cyclotron-resonance data of Galt, Yager, and Dail. (auth)

31972 INFLUENCE OF ^{235}U FISSION FRAGMENTS ON THE FERROMAGNETIC RESONANCE OF SINGLE-CRYSTAL FERRITES. Lebed, B. M.; Ulmanis, U. A.; Mukha, L. Ya.; Mosel, V. I. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser., No. 1, 28-36(1968). (In Russian).

Results are presented of experimental studies on the influence of the radiation defects due to fission fragments resulting from the ^{235}U irradiation. Single-crystal samples of the yttrium and Ca–Bi–V ferrogarnet and lithium ferrites in the temperature range from 77 up to 600°K and in the frequency range from 1,000 up to 16,800 Mhz are studied. A sharp increase in the value and the anisotropy of the line width of ferromagnetic resonance ΔH is established as a result of irradiation. Possible relaxation mechanisms which lead to the ΔH increase are examined. According to the spin–wave theory, there exists an essential effect on the magnetic relaxation in the irradiated single crystals caused by the conditions of degeneracy with the spin states of the spectrum. It is impossible to explain the line width anisotropy by means of the phenomenological theory with anisotropic attenuation parameters because of anisotropic relaxation processes. The nature of these anisotropic processes is found to differ both for the spinel and the garnet structure ferrites. (auth)

31973 THE STUDY OF THE FORMATION OF F CENTRES IN NaCl BY X RAYS BY MEANS OF EXOELECTRON EMISSION.

Seidl, R.; Strelka, V. (Akademie der Wissenschaften, Prague). Czech. J. Phys., 18: 593-600(1968). (In German).

The kinetics of the coloration of NaCl by x rays by means of exoelectron emission is studied. It is shown that this method can be used to investigate the relation between the magnitude of the emission current density and the concentration of color centers. Differences are found between the kinetics of coloration in volume, observed by other authors, and the kinetics of coloration in the surface layer of the crystal. (auth)

31974 STRUCTURE OF GADOLINIUM SESQUISULFIDE. Prewitt, C. T.; Sleight, A. W. (E. I. du Pont de Nemours and Co., Wilmington, Del.). Inorg. Chem., 7: 1090-3(June 1968).

The structure of Gd_2S_3 has been solved and refined by least-squares procedures to an R of 0.019 using 540 nonequivalent reflections collected with a counter diffractometer. Crystals were grown in a GdI_3 melt at 1200°. The crystals are orthorhombic with a = 7.339 Å, b = 15.273 Å, c = 3.932 Å, D_m = 6.14 g cm^{-3}, D_x = 6.187 g cm^{-3} for Z = 4, and space group Pnam. Two kinds of nonequivalent gadolinium atoms are present in Gd_2S_3. One is surrounded by a monocapped trigonal prism of sulfur atoms while the other gadolinium atom is in a bicapped trigonal prism of sulfur atoms. This structure is found for rare earth sesquisulfides from La through Dy and probably also for Pu_2S_3. (auth)

31975 STUDY BY MOESSBAUER EFFECT OF THE Fe NITRIDES ϵ AND ζ IN THE VICINITY OF THE Fe_2N COMPOSITION. Chabanel, Martial; Janot, Christian; Motte, Jean-Pierre (Laboratoire de Physique du Solide, Nancy). Compt. Rend., Ser. A and B, 266: 419-22(Feb. 12, 1968). (In French).

The Fe nitride Fe_2N was studied by Moessbauer effect in its two phases ϵ and ζ. The value of the isomeric displacement makes it possible to propose an electron configuration close to 3-$\underline{d}^9$ 4 s for Fe. The quadrupolar effect observed confirms the structures proposed by Jack. (tr-auth)

31976 EXAMINATION OF THE MAGNETIC RESONANCE SPECTRUM OF THE COPPER NUCLEUS. Tompa, Kalman (Central Physical Research Inst., Budapest). Magy. Fiz. Foly., 16: 1-51(1968). (In Hungarian).

Nuclear magnetic resonance (NMR) measurements on anisotropically oriented single crystals of metals are scarce and the reported data are contradictory. Such measurements were therefore carried out on single-crystal foils of copper in various crystallographic directions; in attempting to evaluate the results, scattering and crystal orientation were considered. The study included an examination of the magnetic interactions between the nuclei and the environment as they affected the NMR spectrum, the behavior of the nuclei in external magnetic fields, the influence of dipole–dipole interactions and of the conductivity electrons on the spectrum, the electric quadrupole interaction, and the relaxation-time-induced widening of the short-spin lattice. The angular correlations of the second momentum of the NMR signals of both copper isotopes, ^{63}Cu and ^{65}Cu, were calculated on the basis of the Van Vleck theory. The surplus momentum values of the two isotopes were found to differ slightly but they were within the experimental error. From this probable value the upper limit of the pseudo (Rudermann–Kittel) exchange was calculated; the value obtained was found to be much lower than that postulated by Refield from the analysis of line width. The Knight shift of the resonance signals of the isotopes was found to be independent of the crystallographic direction. (TTT)

31977 ISSLEDOVANIE ELEKTRONNYKH SVOISTV METALLOV I SPLAVOV. (Studies of Electron Properties of Metals and Alloys). Svechnikov, V. N. (ed.). Respublikanskii Mezhvedomstvennyi Sbornik, Seriya Metallofizika. Kiev, Izdatel'stvo Naukova Dumka, 1967. 135p.

Sixteen articles are included on electronic properties and electron states in metals and alloys. The influence of temperature, composition, plastic and elastic deformation, ordering, and other factors on electronic structure and electronic properties of metals and alloys is analyzed. Studies of superconductivity and magnetic and galvanomagnetic properties of metals are presented. (R.V.J.)

31978 SCATTERING OF FAST ELECTRONS BY NONLOCALIZED EXCITONS OF VAN'E–MOTT. Pundyk, A. V. (Odessa Univ.). Ukr. Fiz. Zh., 13: 338-41(Feb. 1968). (In Russian).

A theoretical estimate of the generation of free excitons of Van'e–Mott by a fast electron beam showed that the angular distribution of scattered electrons varied as $1/\theta^2$ at small scattering angles of θ. The selection rules are the same as with optical excitation of excitons. This result is compared with scattering of an electron beam on previously generated excitons of Van'e–Mott. The incident electron is described by a plane wave normalized to a single particle in a crystal volume. The wave function of the exciton is well known. It is assumed that the exciton is in the 1s state before collision. Expressions are obtained for the differential cross section of elastic scattering and of scattering with excitation and ionization. According to these expressions, inelastic scattering predominates at small angles. The cross section varies as $1/\theta^2$ for scattering with excitation of the 2p state and in the case of ionization. The angular distribution of the probability of generating 2p excitons by an electron beam is the same as in the case of optically forbidden transitions. (TTT)

31979 X-RAY K-ABSORPTION FINE STRUCTURE OF NIOBIUM AND COPPER AT CRYOGENIC TEMPERATURES. Boster, Thomas A. (Oklahoma City Univ., Okla.); Edwards, John E. Phys. Rev., 170: 12-16(June 5, 1968).

The x-ray K-absorption fine structure of niobium and copper has been investigated at 300, 77, and 4.2°K to determine the fundamental dependence of fine-structure variations on the Debye temperature and the location of scattering potentials. The increase in the amplitude of the fine-structure fluctuations with a lowering of absorber temperature and the dependence of fine-structure temperature variations on the Debyé temperature were found to agree with recent theory. No significant change was found in the energy positions of the fine structure as the temperature of the two absorbers was lowered. (auth)

31980 STUDY OF $FeLiO_2$ (β PHASE) BY MOESSBAUER EFFECT. Fatseas, Georges A.; Lefebvre, Simone (Faculte des Sciences, Paris). Compt. Rend., Ser. A and B, 266: 374-6 (Feb. 12, 1968). (In French).

The β phase of $FeLiO_2$ was studied by the Moessbauer effect at 300, 80, and 6.5°K. The analysis of the Moessbauer spectra indicates that the β phase and the α phase both permit a nonzero dipolar field turn in the expression of their internal field. They seem to show a distribution of the values of the electric field gradient. (J.S.R.)

31981 EVIDENCE FOR FRENKEL DEFECT FORMATION IN LOW-TEMPERATURE X-IRRADIATED KCl AND KBr. Balzer, R.; Peisl, H.; Waidelich, W. (Technische Hochschule, Darmstadt, Ger.). Phys. Lett., 27A: 31-2(May 20, 1968).

Combined measurements of lattice parameter and macroscopic length change give evidence that Frenkel defects are created in KCl and KBr during x irradiation at 8°K. (auth)

31982 MAGNETOSTRICTION OF EXCHANGE IN EuO. Busch, G.; Levy, F. (EPF, Zurich). Phys. Lett., 27A: 37-8 (May 20, 1968). (In French).

The magnetostriction of europium monoxide is shown to be proportional to the square of the spontaneous magnetization. (tr-auth)

31983 FERROMAGNETISM IN THE SYSTEM $(Zr_{1-x}Hf_x)Zn_2$. Blythe, H. J. (Sheffield Univ., Eng.). Phys. Lett., 27A: 42-3 (May 20, 1968).

Magnetic measurements in applied fields up to 16 kOe and at temperatures down to 4.2°K have been made on the cubic Laves phase compounds $(Zr_{1-x}Hf_x)Zn_2$ for $0 \leq x \leq 0.16$. The lattice parameter, magnetization and Curie temperature of the system decrease with increase in x. (auth)

31984 INTERPRETATION OF ^{57}Fe ISOMER SHIFT. Dautov, L. M.; Kaipov, D. K. Vestn. Akad. Nauk Kaz. SSR, No. 12, 49-52(Dec. 1967). (In Russian).

The Wolfsberg and Helmholtz method used for direct calculations of electron structure of iron in compounds indicated the configuration of the 3d shell in iron in compounds different from the 3d shell configuration of free ions which suggested a new concept of ^{57}Fe isomer shift. The nuclear charge radius $\Delta R/R$ was found to be ^{57}Fe(14.4 keV) = 5×10^{-4}. (R.V.J.)

31985 LOW-ENERGY PORTION OF THE ELECTRON SPECTRUM ESTABLISHED WITHIN AND EMITTED FROM IRRADIATED CONDUCTING MATERIALS. Burlin, T. E.; Husain, S. R. (The Polytechnic, London). Phys. Med. Biol., 13: 169-79(Apr. 1968).

The saturation characteristic of a parallel-plate vacuum chamber was analyzed to obtain the energy spectrum of low-energy electrons emitted from, and established within, media irradiated by photons. Spectra were obtained for a wide range of atomic numbers at two photon energies, 1.25 and 0.66 MeV, and the results compared with those at low photon energies. The low-energy electron spectra emitted from, and established within, irradiated conducting materials are almost independent of the atomic number of the material and the energy of the photons, while the spectra established within biological materials are probably very similar to those presented. (auth) (UK)

31986 MAGNETIC STRUCTURE OF $TbAg_2$. Atoji, Masao (Argonne National Lab., Ill.). J. Chem. Phys., 48: 3380-3 (Apr. 15, 1968).

Neutron-diffraction measurements have revealed that $TbAg_2$ having the tetragonal CaC_2-type structure becomes antiferromagnetic below the Néel temperature of 35°K. The ordered magnetic structure consists of the ferromagnetic sheets which are perpendicular to the a axis (face-centered description), and the moment directions of the adjacent ferromagnetic sheets are opposite to one another. All moments are aligned in the direction of the c axis, and the saturation moment per Tb is 8.95 ± 0.05 Bohr magnetons which is essentially equal to the ordered moment of the free Tb^{3+} ion. This ordered structure is identical to the commensurable magnetic structure of $TbAu_2$ at temperatures below 42.5°K, but the incommensurable transverse-wavelike spin alignment of $TbAu_2$ found in the 42.5°–55°K range was not detectable in $TbAg_2$. Also, no detectable moment is observed for Ag in $TbAg_2$. (auth)

31987 HEAT CAPACTIY OF α–CERIUM AT A PRESSURE OF 11 KBAR BETWEEN 0.3 AND 6°K. Phillips, N. E. (Univ. of California, Berkeley); Ho, J. C.; Smith, T. F. Phys. Lett., 27A: 49-50(May 20, 1968).

The heat capacity of a single-phase sample of α–Ce has been measured. The magnitude of the electronic heat capacity, determined unambiguously since there is no magnetic heat capacity, indicates a substantial 4f contribution to the density of states. (auth)

31988 AUTO-ION MICROSCOPE INVESTIGATION OF TUNGSTEN IRRADIATED BY 240 MeV ELECTRONS. Garber, R. I.; Dranova, Zh. I.; Mikhailovskii, I. M.; Stratienko, V. A. (Physical-Technical Inst. of Low Temperatures, Kharkov). Zh. Eksp. Teor. Fiz., 54: 1025-7(Apr. 1968). (In Russian).

Radiation damage in crystals produced by high-energy electron bombardment is studied with a field-emission microscope. It is shown that during irradiation at room temperature microscopic cavities with a diameter of 10 Å are produced. The concentration of interstitial atoms in the samples for an integral radiation dose of 10^{16} electrons/cm^2 is ~5 × 10^{17} cm^{-3}. (auth)

31989 INVESTIGATION OF THE MOESSBAUER SPECTRUM OF RESONANCE-SCATTERED NUCLEAR RADIATION FROM ^{57}Fe. Artem'ev, A. N.; Smirnov, G. V.; Stepanov, E. P. Zh. Eksp. Teor. Fiz., 54: 1028-30(Apr. 1968). (In Russian).

The Moessbauer spectrum of resonance γ radiation from ^{57}Fe is investigated. A method is proposed which permits one to measure the relaxation time of nuclei in the excited state. It can facilitate the deciphering of complex Moessbauer spectra. (auth)

31990 NEW PERMANENT MAGNET MATERIALS. Nesbitt, E. A.; Willens, R. H.; Sherwood, R. C.; Buehler, E.; Wernick, J. H. (Bell Telephone Labs., Murray Hill, N. J.). Appl. Phys. Lett., 12: 361-2(June 1, 1968).

New permanent magnet materials containing rare earth elements (RE) have been discovered. For the most part, these alloys are based on the hexagonal intermetallic compounds, Co_5RE. Replacement of cobalt with copper in some of these rare earth compounds results in solid materials with substantial permanent magnet properties. Coercive forces as high as 28,700 Oe have been obtained in heat-treated samples of alloys in the Co_5Sm-Cu_5Sm system. (auth)

31991 NMR STUDY OF THE UO_3–H_2O SYSTEM. Gruener, Gyoergy; Tompa, Kalman; Toth, Ferenc; Poko, Zoltan. KFKI (Kozp. Fiz. Kut. Intez.) Kozlem., 16: 105-16(1968). (In Hungarian).

The proton magnetic resonance spectra of the UO_3-H_2O system were measured at room temperature and at 77°K. The spectra taken on samples of α- or β-type $UO_3 \cdot 2H_2O$ composition show the presence of H_2O and –OH groups. In the sample of the thermal decomposition product of $UO_3 \cdot 2H_2O$, described by the formula $UO_3 \cdot 0.66H_2O$, only –OH groups can be observed. The relative positions of the OH groups do not change appreciably in the crystal lattice; presumably neither diffusion nor rotation takes place, in contrast with the markedly temperature dependent movements of the H_2O molecule. (auth)

31992 AXIAL AND PLANAR DIPS IN REACTION YIELD FOR ENERGETIC IONS IN CRYSTAL LATTICE. Andersen, J. U. Kgl. Dan. Vidensk. Selsk., Mat.-Fys. Med., 36: 26p(1967).

Computer programs have been developed to calculate numerically the dips in yield along low-index directions and planes of energetic positively charged particles emitted isotropically from substitutional sites in a crystal lattice. The calculations are based on Lindhard's theoretical treatment of directional effects and include effects of thermal vibrations of the emitting atoms. The obtained intensity distributions also give the nuclear reaction yield as a function of the direction of an incident beam. (auth)

31993 YADERNYI MAGNITNYI REZONANS V DVIZHUSHCHIKHSYA OBRAZTSAKH. (Nuclear Magnetic Resonance in Moving Objects). Pavlov, O. V. (ed.). Alma-Ata, USSR, Izdatel'stvo Nauka Kazakhskoi SSR, 1968. 123p.

Nine articles are included on theoretical and experimental studies of nuclear magnetic resonance in moving specimens. The problems of nuclear magnetic resonance spectroscopy and methods of binary nuclear–nuclear resonance in moving objects in weak magnetic fields are discussed. Results are given on the studies of nuclear magnetization distribution in fluid flow and of the methods for measuring the nuclear spin–lattice relaxation time. Descriptions are also given of the uses of NMR for recording free radicals, measuring fluid consumption and magnetic field stabilization. Design and performance of NMR devices and instrumentation are discussed and the possibility of using NMR in hydrodynamics is analyzed. (R.V.J.)

31994 LOCATION OF IMPURITY ATOMS IN CRYSTALS USING CHARACTERISTIC X-RAY GENERATION BY CHANNELED PROTONS. Cairns, J. A.; Nelson, R. S. (Atomic Energy Establishment, Harwell, Eng.). Phys. Lett., 27A: 14-15 (May 20, 1968).

A technique is described by which the atomic positions of impurity elements in a crystalline matrix may be examined by using channeled protons as a probe to generate characteristic x rays of the host lattice and of the impurity simultaneously. (auth)

31995 FLUORITE-RELATED OXIDE PHASES OF THE RARE EARTH AND ACTINIDE ELEMENTS. Eyring, Leroy (Arizona State Univ., Tempe). Advan. Chem. Ser., 71: 67-85(1967).

From Symposium on Lanthanide/Actinide Chemistry, New York. See CONF-660962.

Cerium, praseodymium, and terbium oxides display homologous series of ordered phases of narrow composition range, disordered phases of wide composition range, and the phenomenon of chemical hysteresis among phases that are structurally related to fluorite-type dioxides. Hence they must play an essential role in the satisfactory development of a comprehensive theory of the solid state. All the actinide elements form fluorite-related oxides, and the trend from ThO_x to CmO_x is toward behavior similar to that of the lanthanides already mentioned. The relationships among all these fluorite-related oxides must be recognized and clarified to provide the broad base on which a satisfactory theory can be built. (auth)

31996 PHYSICAL CHARACTERIZATION OF THE METALLIC LaI_2 AND CeI_2 AND OF THE PHASE $LaI_{2.42}$. Corbett, John D.; Sallach, Robert A.; Lokken, Donald A. (Ames Lab., Iowa). Advan. Chem. Ser., 71: 56-66(1967).

From Symposium on Lanthanide/Actinide Chemistry, New York. See CONF-660962.

The specific resistance and magnetic susceptibility measured for LaI_2 clearly support the metallic formulation $La^{3+}(I^-)_2e^-$. A comparable temperature dependence of resistivity was obtained for a mixed phase sample of CeI_2. The formation of apparently metallic phases for only the iodides of five lanthanide and actinide elements is considered in terms of the stoichiometry, the electronic structure of the cation, the possible nature of the band, and the role of the anion. In contrast, the intermediate $LaI_{2.42}$ phase exhibits semiconduction. Its magnetic data between 80 and 300°K can be best accounted for if the reduced component is considered to be La^{2+}, [Xe]5d^1, with a $^2T_{2g}$ ground term, a spin-orbit coupling constant λ ~650 cm^{-1}, and only small covalency and asymmetry parameters. (auth)

31997 PREPARATION, STRUCTURE, AND SPECTRA OF SOME TETRAVALENT PRASEODYMIUM COMPOUNDS. Asprey, Larned B.; Coleman, James S.; Reisfeld, Martin J. (Los Alamos Scientific Lab., N. Mex.). Advan. Chem. Ser., 71: 122-6(1967).

From Symposium on Lanthanide/Actinide Chemistry, New York. See CONF-660962.

Several fluoride complexes of tetravalent praseodymium were prepared, and their lattice parameters and absorption spectra were ascertained. The compounds $Na_7Pr_6F_{31}$ and Na_2PrF_6 were prepared by reaction of appropriate mixtures of PrF_3 and NaF in the presence of fluorine gas. PrF_4 was prepared by extracting NaF from Na_2PrF_6 with liquid anhydrous HF in a fluorine atmosphere. The space groups are: $Na_7Pr_6F_{31}$ is rhombohedral ($R\bar{3}$); Na_2PrF_6 is orthorhombic (Immm); and PrF_4 is monoclinic (C2/c). The spectra show characteristic absorption peaks at 2893, 2873, and 2889 cm^{-1} for the three compounds, corresponding to the electronic transition $^2F_{5/2} \rightarrow {}^2F_{7/2}$, and lead to a value of ζ_{4f} = 824 ± 2 cm^{-1}. (auth)

31998 DEVELOPMENTS IN NUCLEAR DOUBLE RESONANCE SPECTROSCOPY. Hahn, E. L. (Univ. of California, Berkeley).

pp 14-24 of Magnetic Resonance and Relaxation. Blinc, R. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From International Conference on Magnetic Resonance and Relaxation, 14th Colloque AMPERE, Ljubljana, Yugoslavia. See CONF-660924.

The nuclear double resonance technique is extended and improved in continuing studies of rare nuclear moment isotopes such as ^{43}Ca in CaF_2, ^{2}D and ^{17}O in $CaSO_42H_2O$, and ^{2}D in certain organic compounds. In all of these cases the abundant fluorine or proton nuclear moment reservoirs (A spins) provide a large resonance signal which is monitored for changes in amplitude while the simultaneous resonance excitation of the rare isotope (B spins) is carried out. The primary improvement in technique involves keeping the rare isotope disordered by rotary saturation, where a separate audio-frequency field is directed along the z axis laboratory magnetic field H_0, or along the principal quadrupole electric field gradient axis (in the case of nuclear quadrupole resonance coupling of the B spins). Some new data regarding detection of quadrupole-coupled ^{23}Na and ^{35}Cl nuclei near impurities in NaCl results as a consequence of further information obtained with the use of frequency modulation, which enables the particular B spin species to be identified both as to nuclear type and location in the crystalline lattice. The technique of adiabatic demagnetization in both rotating and laboratory frames appears to be the most efficient and convenient schema for preparing the A system in order to carry out the double resonance experiment. (M.O.W.)

31999 DYNAMIC NUCLEAR POLARIZATION. Abragam, A. (Centre d'Etudes Nucleaires, Saclay, France). pp 1-13 of Magnetic Resonance and Relaxation. Blinc, R. (ed.). Amsterdam, North-Holland Publishing Co., 1967. (In French).

From International Conference on Magnetic Resonance and Relaxation, 14th Colloque AMPERE, Ljubljana, Yugoslavia. See CONF-660924.

The principle of the "solid-effect" method can be described on two different levels. An elementary theory considers simultaneous flips of electronic and nuclear spins, the energy required for these flips being provided by an external microwave source. In a more sophisticated theory, using the concept of spin temperature in the rotating frame, the electronic spins are through the agency of the microwave field both "cooled" and put "on speaking terms" with the nuclear spins. Various generalizations of the "solid effect" method are best understood using the second language. The experimental situation is presented together with a brief survey of the possibilities opening up in particle physics. Possible improvements for the future are considered. (auth)

32000 MAGNETIC RESONANCE AND RELAXATION. Proceedings of the XIVth Colloque Ampere, Ljubljana, 6-11 September 1966. Blinc, R. (ed.). Amsterdam, North-Holland Publishing Co., 1967. 1255p. $50.00. (In English and French). (CONF-660924).

Separate abstracts were prepared for 26 of the 200 papers. Two papers were previously abstracted as NSA 20: 42525 and 43171. The remaining papers were not considered in scope for NSA. (M.O.W.)

For abstracts of individual papers see: 30641, 31778–31780, 31836, 31998, 31999, and 32001–32019.

32001 ESR OF TRIPLET-STATE TRAPPED HOLE PAIRS IN IRRADIATED Al_2O_3. Cox, R. (Centre d'Etudes Nucleaires, Grenoble, France). pp 279-81 of Magnetic Resonance and Relaxation. Blinc, R. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From International Conference on Magnetic Resonance and Relaxation, 14th Colloque AMPERE, Ljubljana, Yugoslavia. See CONF-660924.

A triplet-state defect found in reactor-irradiated Al_2O_3 is discussed. It is proposed that the defect is a pair of holes trapped on two anions next to a charge-deficient cation site such as a cation vacancy or a monovalent impurity cation; that is, it is a pair of 0^- ions. Such a trapped hole pair can have a triplet ground state. The model has the correct symmetry to explain the six inequivalent lattice sites which are indicated by the ESR spectra. Below -60°C, the two holes are effectively frozen on just two anions. Above -60°C, interesting ESR line-broadening effects show that the holes are jumping 10^8 or more times per second from anion to anion in a triangle of three anions which contains the charge-deficient cation site. The jump rate increases with temperature but the ESR spectrum does not attain true trigonal symmetry up to the annealing temperature (250°C). The reactor-irradiated samples also contain another triplet-state defect with somewhat larger dipolar interaction (D = 3.44 kMc, E = 0.86 kMc). The latter defect can be generated by electron irradiation and, as discussed elsewhere, it also appears to be a trapped hole pair. Presumably, the difference between the two types of hole pair is that they have different trapping centers. (auth)

32002 NUCLEAR MAGNETIC RESONANCE ON RAPIDLY-ROTATED SOLIDS. Andrew, E. R. (Univ. of Nottingham, Eng.). pp 388-93 of Magnetic Resonance and Relaxation. Blinc, R. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From International Conference on Magnetic Resonance and Relaxation, 14th Colloque AMPERE, Ljubljana, Yugoslavia. See CONF-660924.

A review is given of the effects of high-speed rotation on the nuclear magnetic resonance spectra of solids. The rotation introduces a time dependence into the anisotropic interactions of the nuclei. If the rate of rotation is fast enough, the spectrum is largely determined by the time-averaged interactions, the spectral effects of the time-dependent interactions being consigned to weak satellites. In particular, high-speed rotation about an axis inclined at the special angle 54° 44' to the direction of the applied magnetic field has the effect of removing symmetric tensor interactions. Fine structure arising from isotropic shifts and couplings may then be examined as in liquids. The time dependence introduced by rotation may in certain circumstances convert nonsecular into secular interactions and so produce resonant spectral-line broadening. Furthermore, rotation at certain rates may put nonequivalent nuclei on speaking terms and thus promote spin–lattice relaxation by resonant cross relaxation. In pulse work the counterpart of spectral narrowing by specimen rotation is a prolonging of the free induction decay. Experimental methods for propelling specimens at rates of order 10 kc are discussed. (auth)

32003 RESEARCH IN NUCLEAR ACOUSTIC RESONANCE: A SUMMARY. Bolef, D. I. (Washington Univ., St. Louis). pp 335-48 of Magnetic Resonance and Relaxation. Blinc, R. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From International Conference on Magnetic Resonance and Relaxation, 14th Colloque AMPERE, Ljubljana, Yugoslavia. See CONF-660924.

A review is given of research on nuclear acoustic resonance (NAR) in semiconductors, antiferromagnetic dielectrics, and metals. Some detailed studies of InSb are described. Other uses of NAR are also briefly discussed. (M.O.W.)

32004 NEUTRON SCATTERING TECHNIQUE AND RELAXATION PHENOMENA IN LIQUIDS. Skoeld, K.; Larsson, K. E. (Royal Inst. of Tech., Stockholm). pp 78-98 of Magnetic Resonance and Relaxation. Blinc, R. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From International Conference on Magnetic Resonance and Relaxation, 14th Colloque AMPERE, Ljubljana, Yugoslavia. See CONF-660924.

The potential possibilities of the slow-neutron-scattering technique are described. Results obtained on some simple liquids like liquid aluminum and liquid argon, as well as on complex liquids hydrogen-bonded or nonhydrogen-bonded are reviewed. The existence of collective modes in liquids is pointed out. The range of relaxation times possible to study is discussed. (auth)

32005 SPIN-LATTICE RELAXATION OF Er^{3+} IONS ON CUBIC SITES IN THORIUM OXIDE. Berthier, Y. (Faculte des Sciences, Grenoble, France). pp 222-4 of Magnetic Resonance and Relaxation. Blinc, R. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From International Conference on Magnetic Resonance and Relaxation, 14th Colloque AMPERE, Ljubljana, Yugoslavia. See CONF-660924.

The electronic configuration of trivalent erbium is $4f^{11}$ and the fundamental level determined by the spin–orbit coupling is $^4I_{15/2}$. The spin resonance results at 4.2°K, in X band, showed only the Γ_7 line, which must therefore be the fundamental level, together with hyperfine structure. The g-factor isotropy of Γ_7 allowed one to use either a single crystal or a powder, both of concentration 0.5%. The T_1 of the central line between 1.2 and 4.2°K has been measured by the technique of adiabatic fast passage with an apparatus described elsewhere. The decrease in amplitude of the signal with time due to spin–lattice relaxation is exponential. The variation of T_1^{-1} as a function of the temperature showed at very low temperature a direct process, dominated by an Orbach process above 2°K. Between 14 and 20°K, the relaxation time became too short to measure with the present apparatus. This study was extended by measuring line widths. A T^5 law was obtained for T_1^{-1}. Measurements on the satellite lines gave values of T_1 identical to those for the central line. (auth)

32006 NEW DEFECT CENTER IN AMMONIUM HALIDES: MOTIONAL EFFECTS. Patten, F. W. (Naval Research Lab., Washington, D. C.). pp 796 of Magnetic Resonance and Relaxation. Blinc, R. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From International Conference on Magnetic Resonance and Relaxation, 14th Colloque AMPERE, Ljubljana, Yugoslavia. See CONF-660924.

When single crystals of NH_4Cl, ND_4Cl and NH_4Br, which generally have the CsCl structure in these measurements, are irradiated with x rays at low temperature, overlapping EPR spectra of two distinct paramagnetic species are observed. One was determined to be the X_2^- (or V_K) center, where X represents a halogen atom, oriented along one of the three ⟨100⟩ cubic crystal axes in a site of tetragonal symmetry. The other, whose identification is presented here, is believed to be NH_3X, with the N–X bond axis oriented along one of the eight ⟨111⟩ directions. The EPR spectra for the NH_3X species were observed to change reversibly when the temperature was cycled through the interval 90 to 150°K, in a way characteristic of a thermally activated reorientation of the defect center. The low-temperature (<90°K) EPR spectra can be represented by an axial-spin Hamiltonian, with the molecule-fixed z axis along the N–X bond. The high-temperature (>150°K) spectrum for the chloride is interpreted as arising from a rapidly reorienting NH_3 group interacting equally with four chlorine nuclei, presumably in the tetrahedral locations of the surrounding cubic array of halide ions. The NH_3^+ group in the bromide appears to execute a more restricted type of motion at high temperature. A rough value for the activation energy of the reorientating NH_3^+ group in the chloride, assuming an exponential dependence of reorientation frequency on reciprocal temperature, was found to be smaller than expected for rotation of the NH_3^+ group. It is suggested that reorientation may occur by movement of a single hydrogen atom. (auth)

32007 ESR STUDY OF SOME IRRADIATED Cr(VI) COMPOUNDS. Constantinescu, O.; Constantinescu, M.; Pascaru, I. (Inst. of Atomic Physics, Bucharest). pp 777-9 of Magnetic Resonance and Relaxation. Blinc, R. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From International Conference on Magnetic Resonance and Relaxation, 14th Colloque AMPERE, Ljubljana, Yugoslavia. See CONF-660924.

ESR studies were made of polycrystalline $(NH_4)_2CrO_4$ and K_2CrO_4 irradiated by γ rays and by neutrons. The samples were γ irradiated with a ^{60}Co source and with neutrons with integral fluxes of 10^{16} n/cm^2. The ESR spectra were recorded at room temperature and at liquid nitrogen temperature. In the case of polycrystalline $(NH_4)_2CrO_4$, irradiated by γ rays and by neutrons, the parameters of the ESR spectra indicated the formation of Cr(V) and Cr(III), the ratio of signal intensities of the two species being different for the two irradiation types. K_2CrO_4 irradiated under the same conditions, presented ESR spectra having the characteristics of a free radical, which was assigned to a species of CrO_4^- type. The behavior on heating of Cr(V) and Cr(III), formed by irradiation in the range of 25 to 280°C, was observed. An increase of the ESR signal intensity of Cr(V) was found, its maximum being at about 140°C. In the case of Cr(III), the signal intensity increase begins at higher temperatures, yielding a maximum at about 230°C. To elucidate this behavior, the thermal decomposition of nonirradiated $(NH_4)_2CrO_4$ was studied, observing parallelly to the weight loss the appearance of Cr(V) and Cr(III), the evolution of which on heating is similar to that of the irradiated samples. The results obtained lead to the conclusion that in the case of irradiated $(NH_4)_2CrO_4$ reduced species are formed, as for instance Cr(V) and Cr(III), whereas the irradiation of K_2CrO_4 under the same conditions does not lead to the formation of similar species. A radiolytic mechanism for the formation of these paramagnetic species is proposed. (TSS)

32008 ELECTRON SPIN RESONANCE OF CO_3^- ION IN NATURAL X-RAYED CALCITE. Dugas, J.; Bacquet, G. (Faculte des Sciences, Toulouse). pp 775-6 of Magnetic Resonance and Relaxation. Blinc, R. (ed.). Amsterdam, North-Holland Publishing Co., 1967. (In French).

From International Conference on Magnetic Resonance and Relaxation, 14th Colloque AMPERE, Ljubljana, Yugoslavia. See CONF-660924.

An investigation was made on the spectrum of x-irradiated single crystals of natural calcite. These crystals contained less than ten parts per million of manganous ions. Spectra were obtained with a homodyne x-band spectrometer. Before irradiation, only the characteristic spectrum of Mn^{2+} ion first described by Hard et al. was obtained, but with a low intensity. After x irradiation all spectra exhibited, at room temperature and at liquid nitrogen temperature, a supplementary straight and strong line around the g_e value. To avoid its saturation very low modulation fields were used. This, plus the difference between spin–lattice relaxation times T_1 of the manganous ion and the paramagnetic center studied, permitted removal of lines due to Mn^{2+} ions. The observed line has a short lifetime (about 3 days) and is less than 0.2 Gs wide. (TSS)

32009 PULSED NUCLEAR MAGNETIC RESONANCE IN METAL SINGLE CRYSTALS. McLachlan, L. A.; Williams, D. Llewelyn (Univ. of British Columbia, Vancouver). pp 462-7 of Magnetic Resonance and Relaxation. Blinc, R. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From International Conference on Magnetic Resonance and Relaxation, 14th Colloque AMPERE, Ljubljana, Yugoslavia. See CONF-660924.

NMR spectra in tin single crystals at 78°K were measured. Spin–lattice relaxation time and spin–spin relaxation times were measured. (M.O.W.)

32010 ELECTRON MAGNETIC RESONANCE STUDY OF IRRADIATED STARCH. Adamic, K.; Blinc, R. (Inst. Rudjer Boskovic, Zagreb. Nuclear Inst. Josef Stefan, Ljubljana, Yugoslavia). pp 780-5 of Magnetic Resonance and Relaxation. Blinc, R. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From International Conference on Magnetic Resonance and Relaxation, 14th Colloque AMPERE, Ljubljana, Yugoslavia. See CONF-660924.

Electron magnetic resonance investigation of γ-radiation-induced free radicals in starch has been performed. Different natural starchs (potato, corn, wheat), in particular, both fractions of the starch (amylose and amilopectin), amylose iodine complex and retrograded starch were the subject of our study. The effect of crystallinity of the sample, oxygen's atmosphere, adsorbed water and dose of the irradiation on the nature and free radical kinetic were investigated. (TSS)

32011 NMR IN UH_3. Grunzweig, J.; Kuznietz, M. (Technion-Israel Inst. of Tech., Haifa). pp 1224-8 of Magnetic Resonance and Relaxation. Blinc, R. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From International Conference on Magnetic Resonance and Relaxation, 14th Colloque AMPERE, Ljubljana, Yugoslavia. See CONF-660924.

Uranium hydride UH_3 is a ferromagnet with T_c = 181°K. The frequency shift and shape of NMR lines of the protons in the paramagnetic state are analyzed in terms of the magnetic properties of the material. The frequency shift is due to the Ruderman–Kittel interaction between the paramagnetic ions and the proton, while the line width arises from Van Vleck interaction between protons and dipole interactions with the uranium ions. (auth)

32012 SPECTROMETERS FOR EPR DURING IRRADIATION. Galland, D.; Perrin, J.; Santier, C.; Servoz-Gavin, P.; Soutif, M. (Centre d'Etudes Nucleaires, Grenoble, France). pp 797-804 of Magnetic Resonance and Relaxation. Blinc, R. (ed.). Amsterdam, North-Holland Publishing Co., 1967. (In French).

From International Conference on Magnetic Resonance and Relaxation, 14th Colloque AMPERE, Ljubljana, Yugoslavia. See CONF-660924.

In EPR studies of free radicals and other paramagnetic centers created by irradiation of liquids and solids, the signal is usually observed after the irradiation. In some cases, EPR experiments during irradiation should be useful. Examples are studied of the mechanisms involved in generation of paramagnetic centers and the observation of unstable centers. Several workers have studied the creation of free radicals by an electron beam in this way (Buben and Voevodskii). EPR spectrometers were built for experiments under gamma (3.10^6 r/h) or neutron (10^{12} n/cm^2 sec) irradiation in a swimming pool reactor. Besides conventional electronic and microwave components, these spectrometers have two poles, eight meters long, sunk vertically in the swimming pool. (M.O.W.)

32013 TWO MODIFICATIONS AND GENERALIZATIONS OF BLOCH'S MAGNETODYNAMIC EQUATION. Van Gerven, Lieven (Univ. of Leuven, Belg.); Talpe, Jan. pp 845-9 of Magnetic Resonance and Relaxation. Blinc, R. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From International Conference on Magnetic Resonance and Relaxation, 14th Colloque AMPERE, Ljubljana, Yugoslavia. See CONF-660924.

Several theories on paramagnetic resonance and relaxation and paramagnetic resonance line shapes are leading to results which are not valid for arbitrary field strengths. Consequently, they must be considered as limiting case theories which are applicable in high fields only. In that respect, also, the well-known magnetodynamic theory of Bloch fails: it predicts, e.g., zero absorption in zero static field $\bar{H}_s : \chi''(H_s = 0) = 0$, in striking disagreement with experiment. A first modification and generalization of Bloch's basic equation concerns the relaxation of the perturbed magnetization $\overline{M}$. A second modification to Bloch's magnetodynamic equation was made by introducing a second active term. This term represents a reversible variation of the magnetization, due to the presence of internal magnetic fields, and becomes important, of course, when these fields are no longer negligible with respect to the external field. (M.O.W.)

32014 NUCLEAR MAGNETIC RESONANCE IN MAGNETICALLY ORDERED Eu(II) COMPOUNDS. Kuznia, Ch.; Pink, H.; Zinn, W. (Siemens and Halske AG, Munich). pp 1216-21 of Magnetic Resonance and Relaxation. Blinc, R. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From International Conference on Magnetic Resonance and Relaxation, 14th Colloque AMPERE, Ljubljana, Yugoslavia. See CONF-660924.

The NMR of the nuclei ^{151}Eu and ^{153}Eu was studied in the magnetically ordered chalgogenides EuO, EuS, and EuSe. The NMR was measured using an uhf bridge circuit. A coaxial bridge (frequency range 50 to 1000 Mc) was fed by a multi-sweep generator (maximum power 50 mW). One branch of the bridge is terminated by a variable reactance, the other one contains the sample placed at the shorted end of the coaxial line, where the H field is maximum. The bridge signal, corresponding to the reflection coefficient, is displayed vs frequency on an oscilloscope, or is recorded after integration by a lock-in amplifier. NMR signals were observed at temperatures ranging from 1.72 to 37°K in EuO (Curie temperature T_c = 69°K), from 1.54 to 12°K in EuS (T_c = 16.5°K), and from 1.47 to 2.90°K in EuSe (T_c about 6°K). With all three compounds the measured NMR frequencies $\nu(T)$ are found to decrease linearly when plotted vs T^2 indicating that not even in the liquid-helium temperature range is a simple $T^{3/2}$ law valid. (TSS)

32015 DIRECT DIGITAL COMPUTATION OF NMR MOMENTS FROM BROAD-LINE SPECTRA AT VARYING TEMPERATURES. Jones, D. W.; Pearson, J. E. (Univ. of Bradford, Eng.). pp 998-1004 of Magnetic Resonance and Relaxation. Blinc, R. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From International Conference on Magnetic Resonance and Relaxation, 14th Colloque AMPERE, Ljubljana, Yugoslavia. See CONF-660924.

The spectrometer and cryostat are briefly described. The measurement and treatment of spectral data are discussed. (M.O.W.)

32016 A NEW PRECISION MEASUREMENT OF THE RATIO OF THE FREE ELECTRON CYCLOTRON FREQUENCY TO THE NMR FREQUENCY OF PROTONS. Klein, E. (Freie Univ., Berlin). pp 978-80 of Magnetic Resonance and Relaxation. Blinc, R. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From International Conference on Magnetic Resonance and Relaxation, 14th Colloque AMPERE, Ljubljana, Yugoslavia. See CONF-660924.

The conversion factor $e/mc\gamma_p$ is required for the evaluation of g factors from EPR experiments. This quantity can be directly measured, since it is equal to the ratio of the free electron cyclotron (ECR) frequency to the proton NMR frequency. The large space charge shifts of ECR frequency (up to 100 ppM) which occurred in earlier measurements of this type could be greatly reduced by dilution of the electron cloud. It was possible to obtain trapping volumes of about 0.2 cm^3 when slow electrons emitted by an indirectly heated oxide cathode were trapped in an x-band waveguide. At microwave intensities below 10^{-7} typical linewidths were 15 mG (5 ppM). The experiment is still in progress, the preliminary result is $\omega_p/\omega_e = 1.520994 \cdot 10^{-3} \pm 1.5$ ppM (proton sample: H_2O, 0.2 m $CuSO_4$, infinite cylinder). (TSS)

32017 HIGH RESOLUTION SUPERCONDUCTIVE SPECTROMETER: GENERAL PERFORMANCE INFORMATION ON THE DU PONT INSTRUMENT. Nelson, F. A.; Weaver, H. E. (Varian Associates, Palo Alto, Calif.). pp 917-37 of Magnetic Resonance and Relaxation. Blinc, R. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From International Conference on Magnetic Resonance and Relaxation, 14th Colloque AMPERE, Ljubljana, Yugoslavia. See CONF-660924.

The development of superconducting NMR spectrometers is briefly reviewed. Information is given on the instrumentation, cryostat, power supply and associated control circuitry, and the spectrometer of Du Pont. (M.O.W.)

32018 MOESSBAUER EMISSION FROM ATOMS IN RELAXING LOCALIZED MODES. Dash, J. G. (Univ. of Washington, Seattle); Nussbaum, R. H. pp 881-902 of Magnetic Resonance and Relaxation. Blinc, R. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From International Conference on Magnetic Resonance and Relaxation, 14th Colloque AMPERE, Ljubljana, Yugoslavia. See CONF-660924.

Emission of Moessbauer radiation is usually preceded by nuclear events which produce local excitation of the emitting atom and its environment, with a consequent decrease in the probability f of zero-phonon emission. The relaxation of the excitation introduces a modulation of the normally exponential decay of the Moessbauer radiation amplitude, causing it to have a non-Lorentzian line shape. A semi-classical description, for a simple model of relaxing localized vibrational modes, is shown to yield lines of less than natural width if the effects of thermal shift are neglected. When thermal shift is taken into account, lines are asymmetric, and, depending on the relaxation parameters, are either broader or narrower than natural. Computed line shapes for various relaxation parameters are discussed, and the feasibility of experimental detection is indicated. An additional consequence of the time-dependent f is a decrease in the average fraction measured in conventional experiments. The effect of this decrease produces an apparent drop in the atomic force constant at low temperatures. The theory is compared with recent experiments. (auth)

32019 RECOILLESS ABSORPTION OF GAMMA RAYS AND STUDIES OF NUCLEAR HYPERFINE INTERACTIONS IN SOLIDS. Moessbauer, Rudolf L. (Technische Hochschule, Munich). pp 864-80 of Magnetic Resonance and Relaxation. Blinc, R. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From International Conference on Magnetic Resonance and Relaxation, 14th Colloque AMPERE, Ljubljana, Yugoslavia. See CONF-660924.

The potentialities of the gamma resonance method are compared with those of other experimental techniques which are employed in investigations of hyperfine interactions. This discussion stresses the complementary nature of the various techniques. A general survey is given about applications of the gamma resonance absorption technique for measurements of magnetic hyperfine interactions, electric quadrupole interactions, and isomer shifts. Experimental results of gamma resonance measurements performed in compounds of the rare earths are reported. Specifically discussed are: measurements on single crystals in externally applied magnetic fields; measurements of the magnetic hyperfine interactions of second order (pseudo-quadrupole interactions); and a new shift of gamma lines which can be caused by the latter interaction, as well as the influence of electronic relaxation phenomena upon the structure of gamma resonance spectra. (auth)

Theoretical Physics

Refer also to abstract 32180.

32020 (ITF-67-20) ANALYTICITY PROPERTIES OF AN EXPONENTIAL OPERATOR. Bogolubov, N. N. Jr. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1967. 36p. Dep.

A separable Hilbert space H is considered. The quantity L is a self-adjoint operator whose domain D(L) is everywhere dense in H. It is said that L is an operator with discrete spectrum if there exists in H the complete set of eigenvectors of L. An operator T of this kind is considered, and the complete orthonormal set of its eigenvectors is denoted by ϕ_n (n = 1, 2, 3 ...), and the corresponding eigenvalues which are certainly real are denoted by E_n(n = 1, 2, 3 ...). The case when for any $t > 0$ the series $\Sigma_{n=1}^{\infty} e^{-tE_n}$ turns out to be convergent is discussed. (J.F.P.)

32021 (ITF-68-3) K TEORII NERAVNOVESNYKH PROTSESSOV V STATISTICHESKOI MEKHANIKE. I. INTEGRAL'NOE URAVNENIE DLYA MATRITSY PLOTNOSTI. (Theory of Nonequilibrium Processes in Statistical Mechanics. I. Integral Equation for Density Matrix). Peletminskii, S. V.; Yatsenko, A. A. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1968. 32p. (In Russian). Dep.

An integral equation is obtained for the density matrix in the case for which the system state, is described by a reduced set of parameters. As an appendix, the kinetic equations are considered in the case of a small density of particles as well as the kinetic equations for the functions of particle distribution, temperature, and relative rate of two weakly interacting subsystems, respectively. (auth)

32022 (ITF-68-4) K TEORII NERAVNOVESNYKH PROTSESSOV V STATISTICHESKOI MEKHANIKE. II. KINETICHESKIE URAVNENIYA V PRIBLIZHENII SLABOGO VZAIMODEISTVIYA. (Theory of Nonequilibrium Processes in Statistical Mechanics. II. Kinetic Equations in the Weak Interaction Approximation). Bar'yakhtar, V. G.; Peletminskii, S. V.; Yatsenko,

A. A. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1968. 42p. (In Russian). Dep.

In the base of results obtained in Part I the kinetic equations for the one-particle density matrix are considered. The kinetic equation for the non-diagonal one-particle density matrix is obtained in the Λ^1 approximation. When the distribution is uniform, the kinetic equations are obtained in the third and fourth approximation in interaction. (auth)

32023 (ITF-68-5) K TEORII NERAVNOVESNYKH PROTSESSOV V STATISTICHESKOI MEKHANIKE. III. INTEGRAL'NOE URAVNENIE DLYA MATRITSY PLOTNOSTI I ROL' SVOBODNOGO GAMIL'TONIANA V EVOLYUTSII DINAMICHESKOI SISTEMY. (Theory of Nonequilibrium Processes in Statistical Mechanics. III. Integral Equation for Density Matrix and the Role Free Hamiltonian in the Evolution of Dynamical System). Peletminskii, S. V.; Yatsenko, A. A. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1968. 32p. (In Russian). Dep.

On the basis of an asymptotic equation it is shown that at least in perturbation theory the stationary solution of the integral equations for the density matrix obtained in Part I is equivalent to the Gibbs distribution. It is brought to light the role of the free Hamiltonian and the principle of spatial relaxation of correlations for the initial state in the process of the system evolution. An integral equation is obtained for the density matrix applicable for $t \gg \tau_0$ as well as for $t \leq \tau_0$. In an appendix an integral equation is obtained for the generating functional determining the collision integral and many-particle function of distribution. (auth)

32024 THE ASYMPTOTIC EXPRESSIONS OF THE CLASSICAL GREEN FUNCTIONS IN THE VISCOUS HYDRODYNAMICAL APPROXIMATION. Sadovnikov, B. I. (Inst. of Mathematics, Moscow). pp 106-11 of Problema Mnogikh Tel i Fizika Plazmy. Bonch-Bruevich, V. L. Moscow, Izdatel'stvo Nauka, 1967. (In Russian).

A way of deriving the classical Boltzmann equation in the Green's functions method is suggested. A procedure for calculating the Fourier transform of the classical Green's functions in the "viscous hydrodynamical approximation" is developed. (auth)

32025 AN APPLICATION OF THE PATH INTEGRALS METHOD IN THE GREEN'S FUNCTION THEORY OF THE SYSTEMS OF INTERACTING PARTICLES. Kobelev, L. Ya. (Ural State Univ., Sverdlovsk, USSR). pp 56-66 of Problema Mnogikh Tel i Fizika Plazmy. Bonch-Bruevich, V. L. Moscow, Izdatel'stvo Nauka, 1967. (In Russian).

An exact solution of Schwinger's equation (thermodynamical or time-dependent) for the Green's functions of the system of interacting particles is written with the help of functional integration in the space of "external" fields $A(x)$ and "classical trajectories" $x(t)$. The method of approximate integration over "external" fields $A(x)$, which is based on using the power of nonlinear transformations of $A(x)$, is developed. It makes possible to include into considerations longwave fluctuations which may be described by operators of the polarization Π, $\delta\pi/\delta A(x)$ and so on. It is shown that near to the point of the phase transition of the second kind the main role is played by unanalytical parts of the Green's functions which do not appear in the conventional variant of the theory. As illustrations of this method, superconductivity in Gorkov's model, λ transition in Bose gases, and Fermi gases of large density are considered. Near to the points of phase transition the logarithmical dependence of the specific heat is deduced. (auth)

32026 THEORY OF THE MANY-PARTICLE SYSTEMS. Ivanchik, I. I. (Inst. of Physics, Moscow). pp 42-8 of Problema Mnogikh Tel i Fizika Plazmy. Bonch-Bruevich, V. L. Moscow, Izdatel'stvo Nauka, 1967. (In Russian).

An expression for the spectral density of the Schroedinger equation Green function is obtained, which gives an approximate account on the energy spectrum when the potential is arbitrary. This expression is used by calculation of the quantum statistical Green functions. The expressions found apparently contain the bound-state spectrum of the many-particle system. (auth)

32027 EXACT THEOREMS OF THE MANY-BODY THEORY. Bonch-Bruevich, V. L. (Moscow State Univ.). pp 32-41 of Problema Mnogikh Tel i Fizika Plazmy. Bonch-Bruevich, V. L. Moscow, Izdatel'stvo Nauka, 1967. (In Russian).

The thermodynamic properties of the degenerate Fermi systems are considered without use of the notion of the dispersion law (in particular the notion of the Fermi surface is not employed). Thus the results apply as well to the disordered systems with any kind and any strength of the interparticle interaction. The usual linear temperature dependence of the heat capacity is obtained if the density of states is nonzero at the Fermi level. The static electric conductivity of such systems is discussed and shown to be finite at zero temperature if the Fermi level lies in the region where the density of states is nonzero and continuous. (auth)

32028 ON THE CALCULATION OF FREE ENERGY FOR THE MODEL DYNAMICAL SYSTEMS OF THE BCS TYPE. Bogolyubov, N. N. Jr. (Inst. of Mathematics, Moscow). pp 26-31 of Problema Mnogikh Tel i Fizika Plazmy. Bonch-Bruevich, V. L. Moscow, Izdatel'stvo Nauka, 1967. (In Russian).

A model dynamical system of the BCS type is investigated. The complete proof is presented that the well-known approximation procedure leads to the asymptotically exact expression for the free energy, when the usual limiting process of statistical mechanics is performed. (auth)

32029 DIAGRAM RENORMALIZATIONS, VARIATIONAL PRINCIPLES, AND THE INFINITE DIMENSIONAL ISING MODEL. Bloch, Claude (Center of Nuclear Studies, Saclay, France). pp 18-25 of Problema Mnogikh Tel i Fizika Plazmy. Bonch-Bruevich, V. L. Moscow, Izdatel'stvo Nauka, 1967. (In Russian).

A variational principle for a certain soluble model is explored to study the analytical behavior of the partition function near the transition point. (auth)

32030 ON-DIMENSIONAL MANY-PARTICLE SYSTEM WITH TWO-BODY INTERACTION. Berezin, F. A. (Moscow State Univ.). pp 11-17 of Problema Mnogikh Tel i Fizika Plazmy. Bonch-Bruevich, V. L. Moscow, Izdatel'stvo Nauka, 1967. (In Russian).

The relativistic and nonrelativistic one-dimensional many-particle systems with two-body interaction are investigated. In both cases the exact solutions of Lippmann–Schwinger equation and the scattering operator are obtained for point interaction. In the nonrelativistic case the asymptotic behavior of the wave function is found for the generalized Yukawa potential. (auth)

32031 EXPRESSION FOR THE QUANTUM PARTITION FUNCTION IN QUANTUM STATISTICS WITH THE SCATTERING OPERATORS. Berezin, F. A. (Moscow State Univ.). pp 3-10 of Problema Mnogikh Tel i Fizika Plazmy. Bonch-Bruevich, V. L. Moscow, Izdatel'stvo Nauka, 1967. (In Russian).

The formulas connecting the coefficients of virial expansion of the partition function in quantum statistics with the scattering operators are developed. The result for the second coefficient coincides with the well-known Bethe–Uhlenbeck formula. (auth)

32032 PROBLEMA MNOGIKH TEL I FIZIKA PLAZMY. Trudy Mezhdunarodnogo Simpoziuma, Novosibirsk, 1965. (Problem of Many Bodies and Plasma Physics. Transactions of the Symposium, Novosibirsk, 1965). Bonch-Bruevich, V. L. Moscow, Izdatel'stvo Nauka, 1967. 216p.

Separate abstracts were prepared for the 19 individual articles. (M.O.W.)

For abstracts of individual papers see: 31542, 31735, 31736, 31809–31811, 31869, 32024–32031, and 32682–32685.

32033 CANONICAL AND INVOLUTORY TRANSFORMATIONS OF VARIATIONAL PROBLEMS INVOLVING HIGHER DERIVATIVES. Kaplan, S. (Westinghouse Electric Corp., West Mifflin, Pa.). J. Math. Anal. Appl., 22: 45-53(Apr. 1968).

Because of their value in this type of problem it is clearly desirable to extend the notions of canonical and involutory transformation to variational problems involving higher derivatives. Although this extension is straightforward it does not seem to be readily available in the literature. Thus an exposition of the process is given here. Only problems containing second derivatives are considered; however, this case seems sufficient to indicate the pattern for problems with higher derivatives. (W.D.M.)

32034 ROLE OF EQUIVALENCE IN QUANTUM MECHANICS. Greenberger, Daniel (City Coll. of New York). Ann. Phys. (N. Y.), 47: 116-26(1968).

On applying quantum mechanics to the problem of a particle bound in an external gravitational potential, the following results are found, which violate one's classical conception of the principle of weak equivalence: radii, frequencies, etc., depend on the mass of the bound particle; the binding energy has the wrong mass dependence; inertial forces do not look like gravitational forces; and there are mass-dependent interference effects. These inconsistencies disappear in the classical limit, which must be approached in a particular manner. The conclusion is reached that the classical statements one can make using weak equivalence have no direct quantum analog and thus the principle is somewhat irrelevant in discussing low-lying quantum states. (auth)

32035 SYMPOSIA ON THEORETICAL PHYSICS AND MATHEMATICS. 7. Lectures Presented at the 1966 Summer School of the Institute of Mathematical Sciences, Madras, India. Ramakrishnan, Alladi (ed.). New York, Plenum Press, 1968. 193p.

Ten articles are included. Separate abstracts were prepared for five of these. The titles not abstracted are: some notions of local differential topology, Riemann mapping theorem, field of Mikusinski operators, the cosine functional equation, and a novel approach to the kinetic theory of fluids—onset of turbulent motion. (M.H.R.)

For abstracts of individual chapters see: 31762, 32125, 32170, 32231, and 32232.

32036 NATURE OF QUANTUM STATES. Park, James L. (Yale Univ., New Haven). Amer. J. Phys., 36: 211-26(Mar. 1968).

The relations among the statistical ensembles, systems, and states (pure and mixed) of quantum theory are carefully explored. By systematically contrasting the classical and quantal realizations of a general paradigm for a probabilistic physics, important distinctions are exposed both in statics and dynamics. Included are observations concerning the intrinsic ambiguity of the quantum-state concept and the peculiarly quantum property of dynamic indivisibility. It is concluded that the conceptual gulf between classical states and quantum "states" is wider than commonly assumed. (auth)

32037 FIELDS DUE TO A SLOW CHARGED PARTICLE MOVING PARALLEL TO A PLANE-METAL SURFACE. Shier, John S. (Los Alamos Scientific Lab., N. Mex.). Amer. J. Phys., 36: 245-9(Mar. 1968).

A solution is found for the fields due to a charged particle moving parallel to a plane-metal surface in the limit of low velocity. It is found that the current distribution in the metal is mathematically simple; the current density has a dipole pattern of flow. The solution offers interesting examples of charge conservation and the use of the uniqueness theorem in solving potential problems. (auth)

32038 HYPERSPIN FORMULATION OF A MODIFIED PAIRING TREATMENT OF THE BOSE FLUID. Parmenter, R. H. (Univ. of Arizona, Tucson). Phys. Rev., 170: 194-205(June 5, 1968).

A modified pairing treatment is developed for handling the N-boson problem with repulsive particle–particle interaction. The nonpairing portion of the many-boson Hamiltonian is eliminated, to first order, by a canonical transformation. The resultant Hamiltonian contains an additional attractive particle–particle interaction, whenever there is a Bose condensation in the $k = 0$ single-particle state. The Bose condensate plays the same role in mediating this interaction that the phonon field does in mediating the attractive interaction between electrons in a superconductor. The strength of the condensate-induced attractive interaction is approximately double that of the direct repulsive interaction. The region of k space over which the attractive interaction operates depends on N_0, the number of bosons in the condensate, this region vanishing when N_0 does. For convenience, the problem is formulated in terms of hyperspin, in analogy with the isospin treatment of superconductivity. The ground state is characterized by two order parameters Δ_1 and Δ_2, and an energy Γ (proportional to N_0), which can be obtained by solving a set of coupled integral equations. It is shown that there is no gap, at low energies, in the single-particle excitation spectrum. Aside from these single-particle excited states, there are no other collective oscillations. The hyperspin formulation is extended to finite temperatures. There are, however, certain difficulties with this extension. (auth)

PHYSICS (HIGH ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstract 32079.

32039 (COO-1195-124) ANNUAL PROGRESS REPORT [ON PARTICLE PHYSICS]. (Illinois Univ., Urbana. Dept. of Physics). Apr. 1968. Contract AT(11-1)-1195. 36p. Dep. CFSTI.

The high-energy physics research covers experiments using spark chambers and bubble chambers including CP violations, meson decays and interactions, branching ratios, and resonance production. Also spark chamber development and the development of a bubble chamber film analysis system are described. (J.F.P.)

32040 (MIT-2098-422, pp 22-42) HIGH ENERGY ACCELERATOR PHYSICS GROUP. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science).

The experimental program of the high energy accelerator physics group carried out from Oct. 1966 to Oct. 1967 is reviewed. The research during this period include CEA experiments, Brookhaven experiments, and collaborative experiments with other research groups, dealing mainly with photon-nucleon interactions and K-meson decays. (L.B.S.)

32041 DATA ON PARTICLES AND RESONANT STATES. Rosenfeld, Arthur H. (Univ. of California, Berkeley); Barash-Schmidt, Naomi; Barbaro-Galtieri, Angela; Podolsky, William J.; Price, LeRoy R.; Soeding, Paul; Wohl, Charles G.; Roos, Matts; Willis, William J. pp 499-503 of Proceedings of the Heidelberg International Conference on Elementary Particles. Filthuth, H. (ed.). New York, John Wiley and Sons, Inc., 1968.

See CONF-670934.

A table of the stable elementary particles and also resonances is presented. This table includes the masses, mass differences, mean lifetimes or widths, decay modes, branching ratios, spins, and parities. Also general atomic and nuclear constants and some decay parameters are given. These tabulated data are compiled from results prior to September 1967. Some recent data are also listed separately. (J.F.P.)

32042 HIGH-ENERGY PHYSICS AND COSMIC RAY STUDIES IN KAZAKHSTAN. Dobrotin, N. A.; Lukin, Yu. T. (Academy of Sciences, Kazakh SSR, Alma-Ata, USSR). Vestn. Akad. Nauk Kaz. SSR, No. 12, 12-23(Dec. 1967). (In Russian).

A brief review is given on the high energy physics and cosmic ray studies in Kazakhstan. Angular distribution of shower particles in stars formed by high energy particles, relativistic particle energies, the inelasticity coefficient of mesons in showers, resonance interactions and multiple formation of particles, fission of Al, W, and Mo nuclei induced by 660 MeV protons inelastic p-n interactions as 9 GeV, diffraction, π meson generation by 20 GeV protons, inelastic interactions of pions and nucleons in the one-meson approximation are discussed as well as inelastic π-N-interactions at 7.5 GeV and properties of the spark spectrometer for high-energy particles. 18 references. (R.V.J.)

Electromagnetic

32043 DIFFERENTIAL CROSS SECTIONS OF π^+ MESON-PHOTO-PRODUCTION ON PROTONS IN THE 165 to 230 MeV PHOTON ENERGY REGION. Adamovich, M. I.; Larionova, V. G.; Kharlamov, S. P.; Yagudina, F. R. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz., 7: 579-89(Mar. 1968). (In Russian).

Differential cross sections of the process $\gamma + p \rightarrow n + \pi^+$ are measured for 15 angles of meson emission at the 14 values of the photon energy from 165 up to 230 MeV. (auth)

32044 PHOTOPRODUCTION OF VECTOR MESONS ON PROTONS AT ENERGIES UP TO 5.8 GeV. Erbe, R. (Technische Hochschule, Aachen); Hilpert, H. G.; Schuettler, E.; (and others). Phys. Lett., 27B: 54-7(May 27, 1968).

Results for the reactions $\gamma p \rightarrow p\rho^0$, $\gamma p \rightarrow p\rho^0\pi^+\pi^-$, $\gamma p \rightarrow p\omega$, $\gamma p \rightarrow p\omega\pi^+\pi^-$, $\gamma p \rightarrow p\phi$, $\gamma p \rightarrow p\phi\pi^+\pi^-$ are presented. (auth)

32045 FOTOMEZONNYYE PROTSESSY. (Photomeson Processes). Belousov, Anatolii Semenovich. Moscow, Izdatel'stvo Nauka, 1966. 183p.

The physics of elementary particles, specifically that part of it which deals with the production of mesons by high-energy photons (gamma rays) is discussed. The principles underlying the operation of particle accelerators which produce high-energy beams are explained, the physical experiments carried out to demonstrate the finer properties of elementary particles are described, their historical development is traced, and the theory of the relation and interaction between elementary particles is examined. (ATD)

32046 HIGH-ENERGY PHOTODISINTEGRATION OF ^{3}He. Picozza, P. (CNEN, Frascati, Italy); Schaerf, C.; Scrimaglio, R.; Goggi, G.; Piazzoli, A.; Scannicchio, D. Nuovo Cim., 55A: 206-10(May 1, 1968).

Some preliminary results on the two-body photodisintegration of helium-3 in the photon energy region around the first pion-nucleon resonance are reported. The differential cross section for the reaction $\gamma + {}^3He \rightarrow p + d$ using a bremsstrahlung beam for E_γ at 180 to 550 MeV at a cms angle of 90° was measured using scintillation counters in coincidence and spark chambers of conventional design. (J.F.P.)

Weak

32047 (UCID-3162) RANGE-MOMENTUM SCALE FACTOR AND INDEX OF REFRACTION FOR D_2 IN THE 72-INCH B. C. Hoch, P. (California Univ., Berkeley. Lawrence Radiation Lab.). Dec. 12, 1966. Contract W-7405-eng-48. 2p. Dep. CFSTI.

The range of μ^+ from π^+ (stopping) $\rightarrow \mu^+ + \nu$ decay was measured for 193 μ^+'s in a deuterium bubble chamber. The average range R_D was found to be 1.014 ± 0.006 cm. The chamber-dependent scale factor S_D, defined by $R_H = \overline{R}_D + S_D$, was evaluated as S_D = 1.0.0 ± 0.006 for a deuterium bubble chamber. The relation to the index of refraction and the density to the muon range is also noted. (J.F.P.)

32048 (UCR-34-P-107-66) ENERGY SPECTRUM OF π^+ IN $K^+ \rightarrow \pi^+\pi^0\pi^0$ DECAY. Davison, D.; Bacastow, R.; Barkas, W. H.; Evans, D. A.; Fung, S.-Y.; Porter, L. E.; Pu, R. T. (California Univ., Riverside. Dept. of Chemistry); Greiner, Douglas (California Univ., Berkeley. Lawrence Radiation Lab.). Apr. 1968. Contract AT(11-1)-34. 5p. (CONF-680428-1). Dep. CFSTI.

From Conference on Experimental Meson Spectroscopy, Philadelphia, Pa.

The π^+ energy spectrum in $K^+ \rightarrow \pi^+ + \pi^0 + \pi^0$ decay at rest over the entire energy range 0 to 52 MeV was studied. For the preliminary analysis the data consist of 1005 tau decays in photographic emulsions in the π^+ energy region 1 to 21 MeV and 1961 events in a heavy liquid bubble chamber in the π^+ energy region 8 to 52 MeV. Absolute decay rates are not measured so the spectrum in each medium is normalized individually. The best fit parameters and probabilities are summarized. (J.F.P.)

32049 OBSERVATION OF THE $\varphi \rightarrow e^+e^-$ DECAY. Astvacaturov, R. G. (Joint Inst. for Nuclear Research, Dubna, USSR); Azimov, M. A.; Chuvilo, I. V.; (and others). Phys. Lett., 27B: 45-8 (May 27, 1968).

Five events of the $\varphi \rightarrow e^+e^-$ decay were identified using spark chambers and Čerenkov total absorption gamma spectrometers. The probability for these events to be simulated by the background is smaller than 0.1%. New data on the e^+e^--decays of ρ and ω-mesons were obtained. (auth)

32050 EXPERIMENTAL WEAK INTERACTIONS. Willis, W. J. (Yale Univ., New Haven). pp 273-88 of Proceedings of the Heidelberg International Conference on Elementary Particles. Filthuth, H. (ed.). New York, John Wiley and Sons, Inc., 1968.

See CONF-670934.

The review of experimental weak interactions covers evidence for the $\Delta S/\Delta Q$ rule, branching ratios for K^+ and K_1^0 decay, and K_{l3} form factors. Various interactions are discussed, and the results are tabulated and shown graphically. (J.F.P.)

Strong (Baryon-Induced)

Refer also to abstract 32513.

32051 AZIMUTHAL ANGULAR DISTRIBUTION OF SECONDARY PARTICLES IN DIFFRACTIONAL GENERATION. Abduzhamilov, Sh.; Azimov, S. A.; Chudakov, V. M. (Inst. of Nuclear Physics, Tashkent). Yadern. Fiz., 7: 596-9(Mar. 1968). (In Russian).

Azimuthal angular distribution in "clean" and "dirty" stars with the number of secondary shower particles $n_s = 3$ and $n_s = 4$ is studied. The stars are formed in emulsion by 25 GeV/c protons. In a group of "clean" three-prong events azimuthal correlations are observed, i.e., particle momenta tend to be coplanar. These correlations are qualitatively explained by means of the mechanism of the pion-proton diffractional generation. (auth)

32052 ANALYSIS OF ASYMMETRIC SEPARATION OF CHARGED SECONDARY PARTICLES IN C. M. S. FROM pN INTERACTIONS AT E = 20 GeV. Pavlova, N. P. (Inst. of Nuclear Physics, Alma-Ata, USSR). Yadern. Fiz., 7: 600-3(Mar. 1968). (In Russian).

Asymmetric separation of charged secondary particles from pN interactions at E = 20 GeV is analyzed. For the first time the maximal information about the secondary particles is used: the nature of the particles, their energies and angles in cms are determined, measuring the multiple scattering and the ionization. It is shown that at E = 20 GeV the appearance of the asymmetric showers does not exceed the fluctuation limits at all the multiplicities. It is shown also that the asymmetry in the 3-prong events, observed before, may be explained with the contribution from the coherent π-meson production on nuclei of the emulsion. (auth)

32053 TRANSVERSAL MOMENTUM OF SECONDARY SHOWER PARTICLES IN COLLISIONS OF 21-GeV PROTONS WITH THE HEAVY PHOTOEMULSION NUCLEI. **Azimov, S. A.; Chernova, L. P.; Chernov, G. M. (Inst. of Nuclear Physics, Tashkent). Yadern. Fiz., 7: 604-6(Mar. 1968). (In Russian).**

Distributions of transverse momenta of secondary shower particles are investigated from collisions of 20.8 GeV/c protons with the heavy ($N_h > 7$) nuclei of the photoemulsion exposed in the 180 kOe magnetic field. It is shown that the distributions of transverse momenta of positive and negative pions practically coincide. The transverse momenta of pions are almost independent of the emission angle but for protons the mean transverse momentum considerably increases with the emission angle. Observables are compared with those for nucleon-nucleon collisions. (auth)

32054 LIMIT ON THE PRESENCE OF HEAVY STABLE FUNDAMENTAL PARTICLES IN THE PRIMARY COSMIC RADIATION. **Kasha, H. (Brookhaven National Lab., Upton, N. Y.); Stefanski, R. J. Phys. Rev. Lett., 20: 1256-8(May 27, 1968).**

An upper limit for the flux of heavy stable fundamental particles in the primary cosmic radiation is presented which is about two orders of magnitude less than that suggested to explain the anomalous cosmic-ray muon spectrum. (auth)

32055 DIFFRACTION-LIKE STRUCTURE IN ELASTIC PROTON-PROTON SCATTERING AT LARGE MOMENTUM TRANSFERS. **Allaby, J. V.; Diddens, A. N.; Klovning, A.; Lillethun, E.; Sacharidis, E. J.; Schluepmann, K.; Wetherell, A. M. (CERN, Geneva). Phys. Lett., 27B: 49-53(May 27, 1968).**

Measurements of wide angle elastic p-p scattering between 7 and 12 GeV/c are reported. Structure found in the angular distributions is suggestive of diffraction. (auth)

32056 MEASUREMENT OF THE ASYMMETRY PARAMETER FOR Σ^- LEPTONIC DECAY. Gershwin, Lawrence K.; Alston-Garnjost, Margaret; Bangerter, Roger O.; Barbaro-Galtieri, Angela; Solmitz, Frank T.; Tripp, Robert D. (Univ. of California, Berkeley). Phys. Rev. Lett., 20: 1270-2(May 27, 1968).

Using polarized Σ^- hyperons, the up-down asymmetry of leptons in the decay $\Sigma^- \rightarrow nl^-\bar{\nu}$ was measured. This leads to a value of $g_A/g_V = 0.05^{+0.13}_{-0.32}$, in reasonable agreement with the Cabibbo theory for leptonic decays. (auth)

32057 BARYONIC RESONANCES WITH S ≠ 0. Meyer, J. (CEN, Saclay, France). pp 117-55 of Proceedings of the Heidelberg International Conference on Elementary Particles. Filthuth, H. (ed.). New York, John Wiley and Sons, Inc., 1968.

See CONF-670934.

A complete review is not given, but rather the methods applied are given and their shortcomings are discussed. These methods are illustrated by some of the most significant results obtained from them. The various cross sections and angular and mass distributions are shown for these baryon resonances. (J.F.P.)

32058 PROTON-PROTON INTERACTIONS AT 6 GeV/c. Caso, C. (Univ., Genoa. Istituto Nazionale di Fisica Nucleare, Genoa); Conte, F.; Tomasini, G.; Case, L.; Mosca, L.; Ratti, S.; Tallone-Lombardi, L.; Bloodworth, I.; Lyons, L.; Norton, A. Nuovo Cim., 55A: 66-99(May 1, 1968).

About 5500 events with four charged secondaries and 900 events with two charged secondaries plus neutral strange particles were analyzed in the 1.5-m hydrogen bubble chamber, exposed to a proton beam of 6 GeV/c incident momentum. Cross sections for the various channels are reported and compared with similar results at other energies. The contribution of the various (Nπ) and (Nππ) isobars to the multipion final states has been estimated, taking into account the peripheral character of the interaction to evaluate the background. All reactions are strongly dominated by the production of the N^*_{1236} isobar, with a total cross section $\sigma_{N^*_{1236}} = (6.6 \pm 0.6)$ mb. In the $pp\pi^+\pi^-$ channel, the N^{*++}_{1236} is produced in 40% of the cases in association with one of the N^{*0}_{1236}, N^{*0}_{1512} or N^{*0}_{1688} isobars, yielding for this channel a total cross section for double isobar production $\sigma_d = (1.1 \pm 0.2)$ mb. Double isobar production does not seem to be important in the 5-body channels. Among boson resonances, there is evidence for ω ($\sigma_\omega = (0.18 \pm 0.05)$mb) and $\eta(\sigma_\eta = (0.07 \pm 0.05)$mb) production, and an upper limit of 250 μb has been set for ρ production. There is no significant evidence for the $I = {}^5/_2\ p\pi^+\pi^+$ isobar. Strong peripherality of the interaction, and abundant production of Y_{1385} is reported in the strange particle events. (auth)

32059 ANTIPROTON-PROTON ANNIHILATION INTO ($K\bar{K}$ + 3π) AND ($K\bar{K}$ + 4π) AT 1.2 GeV/c STUDY OF THE D^0 PROPERTIES. D'Andlau, C. (College de France, Paris); Barlow, J.; Adamson, A. M.; Donald, R. A.; (and others). Nucl. Phys., B5: 693-713(1968).

Experimental results are presented for the five- and six-body annihilations $\bar{p}p \rightarrow K\bar{K}3\pi$ and $\bar{p}p \rightarrow K\bar{K}4\pi$ of 1.2 GeV/c antiprotons. Analysis of these results in terms of production of $K^*(890)$, ρ, ω, η, and D(1280) resonances is made. A detailed analysis of the quantum numbers for the D-meson is given. (auth)

32060 MULTIPLICITY AND ANGULAR DISTRIBUTION OF SECONDARIES IN HIGH-ENERGY JETS. **Imaeda, K. (Dublin Inst. for Advanced Studies). Nuovo Cim., 55A: 100-9(May 1, 1968).**

The experimental multiplicity and angular distribution of the secondary particles of high-energy nuclear interactions are analyzed. The manner in which the estimate of dispersion σ of the log tg θ representation of the angular distribution of the secondaries varies with the energy of the primary, is studied. Based on the observed results, a distribution function which explains both the σ and multiplicity distribution is suggested. By appropriate application of that empirical relation to the "fireball model," the distributions of the mass and Lorentz factor of the fireball are derived. (auth)

32061 SMALL ANTIPROTON-COMPLEX NUCLEI ELASTIC SCATTERING ANGLES AT 3 GeV/c. **Bermond, Jacques; Brou, Rene; Flard, Michel; Le Querler, Yves (Faculte des Sciences, Caen, France). Compt. Rend., Ser. A and B, 266: 440-3(Feb. 12, 1968). (In French).**

The parameters of the optical model were determined beginning with an experimental distribution of small angles of elastic scattering of antiprotons at 3 GeV/c on the complex nuclei of ionographic emulsions. The values found were $R_0 = 1.37 \pm 0.10$ fermi, $V_0 = 23 \pm 8$ MeV, and W = 32 ± 10 MeV for the scattering angles whose horizontal projection belongs to the interval from 3 to 39 mrd. (tr-auth)

Strong (Meson-Induced)

Refer also to abstracts 32057, 32060, and 32723.

32062 (UCID-3164) Σ^+ ANALYSIS BIASSES IN K63 EXPERIMENT. Bock, R. K.; Stirling, A. V. (California Univ., Berkeley. Lawrence Radiation Lab.). July 7, 1966. Contract W-7405-eng-48. 21p. Dep. CFSTI.

In analyzing decays of Σ^+ particles strong deviations from the expected behavior of these particles were found. Success was found in explaining most of the discrepancies in terms of scanning and program biasses. (auth)

32063 INTERACTION OF OXYGEN, CARBON MONOXIDE, AND NITROGEN WITH (001) AND (110) FACES OF MOLYBDENUM. **Hayek, K.; Farnsworth, H. E.; Park, R. L. (Brown Univ., Providence). Surface Sci., 10: 429-45(June 1968).**

A combination of low-energy electron diffraction and retarding potential measurements was employed to study gaseous adsorption on atomically clean (001) and (110) Mo single crystal surfaces. Adsorption of oxygen on the (001) surface at room temperature occurred with a sticking coefficient close to unity and produced a large increase in work function and appreciable changes in the intensity distributions of the integral order diffraction beams, without the appearance of any new diffraction beams. These results indicate that a surface monolayer of oxygen was formed with a unit mesh having the same dimensions as that of the underlying molybdenum surface. Exposures above 6×10^{-3} torr-sec produced a uniform decrease in intensities, thus indicating a second monolayer with amorphous structure. On heating, two additional surface structures were observed, characterized by one-half and one-third order beams, respectively. A clean surface was obtained by heating above 1100°C. An exposure of 1 to 7×10^{-7} torr-sec of oxygen for the (110) face resulted in two types of patterns characteristic of lattices with one-quarter and one-half the surface density of the (110) Mo face, with an increased work function accompanying the latter pattern. Exposure of the clean surface at 400 to 800°C produced similar patterns of enhanced intensities with no increase in work function. Possible models are discussed. It is concluded that place exchange models account for these results, as well as the one-half and one-third order structures on the (001) face, in a more satisfactory manner than adsorption above the surface. An exposure to 10^{-5} torr-sec produced a monolayer coverage with a unit mesh similar to that of the molybdenum substrate. Additional exposure resulted in further amorphous adsorption. Adsorption of CO produced changes in the intensity distributions, with the appearance of no new maxima, for both (001) and (110) Mo surfaces. Nitrogen, at an exposure of 3×10^{-3} torr-min did not adsorb on either the (001) or (110) Mo surface, but when dissociated by electron impact it adsorbed on both Mo surfaces with the same dimensions of unit mesh as those of the Mo substrates and with an increase in work function of 1.05 eV for the (001) and 0.05 eV for the (110) surface. (auth)

32064 METASTABLE SURFACE STRUCTURE OF THE W(110) FACE. Baudoing, R. (Faculte des Sciences, Grenoble, France); Stern, R. M. Surface Sci., 10: 392-8(June 1968).

The observation of a new metastable phase on the (110) tungsten surface contaminated with carbon is reported with an explanation based on a model of surface deformation in the (110) plane. The transition from the stable C1 structure to the metastable C2 structure is reversible and this cycle is reproducible. (auth)

32065 GROWTH OF OXIDE FILMS ONTO CLEAVAGE FACES OF CRYSTALLINE UC. Camagni, P.; Manara, A.; Landais, E. (CCR-EURATOM, Ispra, Italy). Surface Sci., 10: 332-48(June 1968).

Thin films of uranium oxide, formed by treating cleavage faces of single-crystal UC in purified oxygen, were measured with the help of two optical methods based on ellipsometry. The characteristics of fine-scale oxidation were thus determined at 5 temperatures in the range from 60 to 160°C. In the main, the isothermal growth of the oxide layer appears to be parabolic, with thickness increasing linearly in the square root of the oxidation time; the rate-constant of the process is thermally activated. Both features are indicative of a diffusion-limited process in which the reaction proceeds by way of oxygen migration through the growing film. In this frame, a qualitative argument indicates that the observed heat of activation can be connected to the migration energy of the oxygen atoms (or ions) in the oxide layer. The estimate for the latter is 25 kcal/mol, in good agreement with the data from diffusion experiments in UO_2. (auth)

32066 DETECTION AND INTERPRETATION OF VERY SHORT RANGE HYPERFRAGMENTS. Bohm, G. (Forschungsstelle fuer Physik hoher Energien, Berlin). Phys. Lett., 26B: 733-6(May 13, 1968).

With the aid of geometry measurements a quotum of (9.3 ± 2.1)% hyperfragments from 1.5 GeV/c K^--interactions with emulsion nuclei was determined. Their projected range- and angular distributions were compared with predictions from the spallation model. (auth)

32067 DOUBLE CHARGE EXCHANGE IN π^+-HELIUM SCATTERING. Carayannopoulos, N.; Head, J.; Kwak, N.; Manweiler, J.; Stump, R. (Univ. of Kansas, Lawrence). Phys. Rev. Lett., 20: 1215-16(May 20, 1968).

Data on the $\pi^+ + He \rightarrow \pi^- + 4p$ reaction obtained from an exposure of 610-MeV π^+ in the ANL 10-in. superconducting magnet bubble chamber were analyzed using a phase-space model. The model is based on the assumption that the process involved is $\pi^+ + 2n \rightarrow \pi^- + 2p$. An attempt was also made to fit the experimental data with other models; less satisfactory results were obtained. It is concluded from the general agreement of the data with the phase-space model that the double-charge-exchange process is mainly a three-particle process involving two nucleons of like charge, and that the process depends on the nucleon-nucleon correlations. (L.B.S.)

32068 INCOHERENT MULTIPLE PRODUCTION OF PARTICLES IN COLLISIONS OF 200 GeV PIONS WITH NUCLEI OF PHOTOGRAPHIC EMULSION. Gierula, J.; Krzywdzinski, S. (Inst. of Nuclear Research, Krakow). Nuovo Cim., 55A: 370-6(May 21, 1968).

The results are presented of an analysis of the multiplicity distributions, average inelasticity coefficients, and angular distributions of particles produced in collisions of 200-GeV pions with emulsion nuclei. (L.B.S.)

32069 PRODUCTION OF STRANGE PARTICLES IN HEAVY NUCLEI OF EMULSION FROM THE INTERACTIONS OF π^- OF 17 GeV/c. Kamal, A. A.; Rao, R.; Rao, Y. V. (Osmania Univ., Hyderabad, India). Nuovo Cim., 55A: 357-8(May 21, 1968).

In a stack of G-5 emulsions exposed to a π^- beam of 17.2 GeV/c at CERN, 619 stars with $N_s > 3$, obtained from "along the track" scanning, together with 2659 stars found in area scanning were selected for the study of strange particles. The contribution to the yield of $\Sigma^\pm$-hyperons and $K^\pm$-mesons from the secondary particles and from the beam particles in the velocity interval $0.41 < \beta < 0.77$ is investigated. It is concluded that about half of the observed strange particles originate from the interactions of secondary pions and the other half from the energy degradation of particles produced in the primary interactions. (L.B.S.)

32070 RADIATIVE CORRECTIONS TO THE LEPTONIC-DECAY MODES OF THE NEUTRAL VECTOR MESONS ρ, ω, ϕ. Ehlotzky, F. (CERN, Geneva); Mitter, H. Nuovo Cim., 55A: 181-92(May 1, 1968).

The radiative corrections to the leptonic decay rate $\Gamma(V \rightarrow l^+l^-)$ of a neutral vector meson $V \equiv \rho^0$, ω or φ are evaluated for $l^\pm \equiv e^\pm$ or $\mu^\pm$ including the contributions due to the emission of hard photons. Admitting a radiative energy loss of at least 10% of the total cm energy of the decaying system, the radiative corrections are found to reduce $\Gamma(V \rightarrow e^+e^-)$ by at most 10% and to hardly change $\Gamma(V \rightarrow \mu^+\mu^-)$ in the range of cm energies from 500 to 1500 MeV. (auth)

32071 STUDY OF STRUCTURE IN THE "A_2(1300)" REGION IN π^-p INTERACTIONS AT 6 GeV/c. Crennell, David J.; Karshon, Uri; Lai, Kwan Wu; Scarr, J. Michael; Skillicorn, Ian O. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Lett., 20: 1318-21 (June 3, 1968).

In a bubble-chamber experiment a splitting of the "A_2(1300)" was observed similar to that observed in the CERN missing-mass experiment. Analysis of the $K_1^0K_1^0$ system indicates that there are two different resonances in the "A_2" region. (auth)

32072 STUDY OF A_2^- IN $\pi^-p \rightarrow \pi^-p\eta^0$ AT 5 BeV/c. Ascoli, G.; Crawley, H. B.; Mortara, D. W.; Shapiro, A.; Bridges, C. A.; Eisenstein, B. I.; Kruse, U. E.; Shafter, E. D.; Terreault, B. (Univ. of Illinois, Urbana). Phys. Rev. Lett., 20: 1321-4(June 3, 1968).

A study of the reaction $\pi^-p \rightarrow \pi^-p\eta^0 \rightarrow \pi^-p\pi^+\pi^-\pi^0$ at 5.0 BeV/c is reported, which gives clear evidence for $A_2^- \rightarrow \eta^0\pi^-$. The observed branching ratio is $R = (A_2^- \rightarrow \eta^0\pi^-)/[A_2^- \rightarrow (\rho\pi)^-] = 0.23 \pm 0.08$, and the observed polarization of the A_2 is $2\rho_{11} \simeq 1$, $\rho_{1-1} = \rho_{-11} \simeq 0.5$. Evidence is also obtained for $A_2^- \rightarrow X^0\pi^-$ with an observed branching ratio of $(A_2^- \rightarrow X^0\pi^-)/[A_2^- \rightarrow (\rho\pi)^-] = 0.07 \pm 0.03$. (auth)

32073 LAMBDA PRODUCTION IN 10 GeV/c K^-p INTERACTIONS. Aderholz, M. (Technische Hochschule, Aachen); Grote, C.; Bardadin-Otwinowska, M.; Goldsack, S. J.; Kittel, W.; (and others). Nucl. Phys., B5: 606-18(1968).

Lambda production in 10 GeV/c K^- interactions in hydrogen is studied. Cross sections are given for resonance production in quasi-two-body and many-body reactions, and their energy dependence is studied. It is found that the cross sections for quasi-two-body reactions requiring exchange of a strange meson decrease faster than that for the reaction $K^-p \rightarrow pK^{*-}(890)$ which requires exchange of a non-strange meson. The cross section for $Y^{*-}(1385)$ production decreases faster than that for $Y^{*+}(1385)$ in quasi-two-body reactions. The distributions of the lambda c.m. production angle, transverse momentum and c.m. longitudinal momentum as a function of the particle multiplicity are studied. (auth)

Particle Interactions and Properties (Theoretical)

32074 (MIT-2098-422, pp 106-42) THEORETICAL GROUP. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science).

Summaries and abstracts are presented of the research completed at MIT from Oct. 1966–1967 on the following topics: nuclear forces; nuclear structure and nuclear forces; models and the Hartree–Fock approximation; scattering and reactions; quark model; the angular momentum plane; current algebra; P.C.A.C., and soft pion phenomena; phenomenological approaches; quantum electrodynamics and field theory; and the three-body problem. (L.B.S.)

General

32075 (IS-1815) LECTURES ON DESCRIPTION OF PARTICLES WITH ANY SPIN AND WITH INTERNAL SYMMETRY. Good, R. H. Jr. (Ames Lab., Iowa). Apr. 1968. Contract W-7405-eng-82. 40p. Dep. CFSTI.

A free particle with rest mass and spin $s = 0, \frac{1}{2}, 1, \ldots$ can be described conveniently by a $2(2s + 1)$ - component wave function of Lorentz type $(0, s) \oplus (s, 0)$. An advantage of this description is that it simplifies field-theory-type calculations of reactions. A review of the description is given including some of the discussions and proofs that have not been written up before. The c-number theory and the quantization process are discussed in detail. The charge conjugation quantum number and the inclusion of isospin coordinates are also covered. (auth)

32076 NATURAL HISTORY OF BARYONS. Nyiri, Julia (Central Research Inst. for Physics, Budapest). Magy. Fiz. Foly., 16: 81-109(1968). (In Hungarian).

The about 200 currently known elementary particles are classified on the basis of their symmetry properties. Of the many proposed systems, the octet model advanced by M. Gell-Mann and Y. Ne'eman was found to be most successful. It postulates that the strong interactions are invariant with respect to the transformations of the SU_3 group. The strongly interacting particles with identical spin and parity may be identified by certain irreducible representations of the SU_3 group. It is assumed that the $\frac{1}{2}^+$-parity 8-baryon belongs to an octet representation; the degenerate supermultiplet is broken up by semi-strong interactions into known isoplets and multiplets. Gell-Mann identifies the vector mesons as an SU_3 octet. The decay of the $\frac{3}{2}^+$ decuplet is reviewed in detail. The weak interaction of Ω-hyperons is also examined. In the study of the decay of the $\frac{1}{2}^+$ baryon octet consideration is given to the effect of weak electromagnetic interactions, reviewing the experimental technique employed for studying lepton decays, considering also nonleptonic processes. It is concluded that application of the symmetry principles yields excellent results in the classification of elementary particles, as it allows their properties to be predicted; however, further experimental studies are needed. (TTT)

32077 TRANSITION AMPLITUDES IN CONTINUOUS SPECTRUM FOR MANY-PARTICLE SYSTEMS. Tsekhmistrenko, Yu. V. (Inst. of Physics, Kiev). Yadern. Fiz., 7: 696-705(Mar. 1968). (In Russian).

On basis of the formalism developed previously a set of coupled integral equations is deduced for amplitudes of various transitions in the continuous spectrum in a system with an arbitrary number of particles interacting in an arbitrary way. These amplitudes are shown to coincide with the T-matrix elements on the energy shell. A rearrangement, simple in principle, gives rise to a new set with kernels that have no δ-functions and consequently, provide the set to be a Fredholm one, under some restrictions on the potentials. The shape of the set of equations makes one able to prove some known approximated schemes, e.g., the distorted wave Born approximation, for reactions with rearrangements of particles in a mathematically consistent way, as well as to formulate the method of strongly coupled channels. (auth)

32078 FUNDAMENTAL THEORETICAL QUESTIONS. Hepp, Klaus (Eidgenoessische Technische Hochschule, Zurich). pp 1-8 of Proceedings of the Heidelberg International Conference on Elementary Particles. Filthuth, H. (ed.). New York, John Wiley and Sons, Inc., 1968.
See CONF-670934.

The discussion of theoretical questions includes the purpose of axioms, difficulties of deductions, linear and nonlinear programs, particle interpretation, locality, quantum electrodynamics, Haag and Fermi fields, operator dynamics, and Green function equations. (J.F.P.)

32079 PROCEEDINGS OF THE HEIDELBERG INTERNATIONAL CONFERENCE ON ELEMENTARY PARTICLES HELD SEPTEMBER 20-27, 1967. Filthuth, H. (ed.). New York, John Wiley and Sons, Inc., 1968. 559p. $27.50. (CONF-670934).

The conference included 20 papers three of which were abstracted previously in NSA. For abstracts of these papers see abstract numbers: 22:11568, 22:13822, and 22:24623. Separate abstracts are prepared for 17 papers. (J.F.P.)

For abstracts of individual papers see: 32041, 32050, 32057, 32078, 32080, 32081, 32088, 32089, 32100, 32101, 32119-32121, 32151, 32152, 32156, and 32178.

32080 REPRESENTATION OF CURRENT ALGEBRA AT INFINITE MOMENTUM: SOLUTION OF THE CASE IN WHICH ISOTOPIC SPIN FACTORS OUT. Gell-Mann, Murray (California Inst. of Tech., Pasadena); Horn, David; Weyers, Jaques pp 479-95 of Proceedings of the Heidelberg International Conference on Elementary Particles. Filthuth, H. (ed.). New York, John Wiley and Sons, Inc., 1968.
See CONF-670934.

The equations obtained by Dashen and Gell-Mann for the matrix elements of the vector and axial vector charge densities at $P_z = \infty$, describing the requirements of the algebra and of relativistic invariance, are reviewed. A simplified version of the problem of representing the current algebra at infinite momentum, one in which all the matrix elements of the vector and axial vector charge densities are simply proportional to the vector charges, is treated. Expansion around the case of degenerate masses is discussed, and a very general type of solution of the simplified problem is presented in covariant and closed form. Also the possibility of solving the problem in which the currents are not always proportional to the charges is considered. (J.F.P.)

32081 CURRENT ALGEBRA. Fubini, S. (Univ., Turin. Massachusetts Inst. of Tech., Cambridge). pp 425-35 of Proceedings of the Heidelberg International Conference on Elementary Particles. Filthuth, H. (ed.). New York, John Wiley and Sons, Inc., 1968.
See CONF-670934.

In the discussion of current algebra, restriction is made to low-energy theorems, field algebra, and spectral function sum rules. The topics considered are fundamental commutators, the generalized Ward identity, soft pion theory, vector dominant models, and the algebra of fields. (J.F.P.)

32082 AXIAL VECTOR RENORMALIZATION CONSTANT FROM ALGEBRA OF CURRENTS. II. Pattnaik, Mamata (Saha Inst. of Nuclear Physics, Calcutta). Ann. Phys. (N. Y.), 47: 103-15(1968).

A general sum rule connecting the matrix elements of the SU(4) current operators between zero momentum states, characterized by arbitrary spin and isospin quantum numbers is derived using SU(4) current commutation relation and Racah algebra. The sum rule thus obtained gives more insight into the problem and reproduces the results obtained previously for calculating the axial vector renormalization constant. (auth)

32083 GRAVITATIONAL COUPLING CONSTANT OF ELEMENTARY PARTICLES. Efinger, H. J. (Dublin Inst. for Advanced Studies. Univ. of Georgia, Athens). Nuovo Cim., 55A: 199-202(May 1, 1968).

A theory that determines the wave function together with the gravitational potential of particles is presented. An expression is obtained for the gravitational coupling constant by means of a variational ansatz, and a lower mass limit for elementary particles is predicted. The latter is true if the gravitational field carries a finite mass. The starting assumption is that any gravitating particle regardless of its complicated structure obeys the Schrödinger equation. This theory is not in contradiction with the theory of gravitation in the nonrelativistic limit, but is not in harmony with Einstein's principle of general covariance. It is emphasized that the model is based on various approximations that make it necessary to study more extensively the problem of gravitating elementary particles which are subject to quantum theory. (J.F.P.)

Electromagnetic

32084 ON COHERENT DISSOCIATION $\pi \to 2\pi$ IN THE NUCLEAR FIELD AND THE POSSIBILITY OF OBSERVING THE $\gamma\pi \to 2\pi$ REACTION. Iroshnikov, G. S.; Nikitin, Yu. P. (Moscow Engineering-Physics Inst.). Yadern. Fiz., 7: 616-19(Mar. 1968). (In Russian).

Explicit conditions are considered that make it possible to measure the cross section of the pion photoproduction on pions studying the $\pi \to 2\pi$ dissociation in nuclear field. (auth)

32085 VECTOR DOMINANCE IN PHOTOPRODUCTION. Dar, A. (Massachusetts Inst. of Tech., Cambridge); Weisskopf, V. F.; Levinson, C. A.; Lipkin, H. J. Phys. Rev. Lett., 20: 1261-5(May 27, 1968).

It is shown that present data on photoproduction support the vector-dominance assumption for the hadron electromagnetic current in direct tests which require almost no additional symmetry- or model-dependent assumptions. Agreement with predictions is obtained for both the angular distribution and the magnitude of the photoproduction cross section over a wide energy range. New model-independent experimental tests of vector dominance in photoproduction are proposed. (auth)

32086 DIFFERENCE OF NUCLEON AND PION ELECTROMAGNETIC RADII. Drell, S. D.; Silverman, Dennis J. (Stanford Univ., Calif.). Phys. Rev. Lett., 20: 1325-9(June 3, 1968).

The nucleon isovector Pauli radius $\langle R_{2V}^2\rangle$ is calculated, using sidewise dispersion relations, to be significantly larger than the predictions of ρ dominance, in accord with observation. It is also predicted that $\langle R_{2V}^2\rangle$ is significantly larger than the pion charge radius $\langle R_\pi^2\rangle$. Elastic scattering of pions from electrons at very high energies (viz. Serpukhov) will give a clear confrontation with this prediction. (auth)

32087 A THEORETICAL FOUNDATION FOR HOFSTADTER–WILSON FORMULA. Narita, Takao (Tohoku Gakuin Univ., Japan). Progr. Theor. Phys. (Kyoto), 39: 228-9(Jan. 1968).

A possible theoretical foundation is given for the equation $G_E(q^2) = G_M(p^2)/\mu = (q_1^2/q_1^2 + q^2)$ which was proposed by Hofstadter and Wilson for describing the large momentum transfer data for proton electromagnetic form factors. In this theory the Regge pole model is combined with SU(3) symmetry. (J.F.P.)

32088 RADIATIVE CORRECTIONS TO VECTOR β-DECAYS. Maiani, L. (Istituto Superiore di Sanita, Rome). pp 436-41 of Proceedings of the Heidelberg International Conference on Elementary Particles. Filthuth, H. (ed.). New York, John Wiley and Sons, Inc., 1968.

See CONF-670934.

The discussion of radiative corrections to vector beta decays includes early calculations showing that to the order α radiative corrections to the decay of a pointlike muon through a V–A interaction are finite whereas to the same order the corresponding corrections for a pointlike neutron are logarithmically divergent, the $\pi^- \rightarrow \pi^0 + e^- + \nu_e$ decay, and the relevance of axial terms, also results of the quark and SUB models, and the assumption that weak decays are mediated by an intermediate charged boson are briefly described. (J.F.P.)

32089 PHOTOPRODUCTION OF SINGLE PIONS BELOW 1.5 GeV. Rollnik, H. (Univ., Bonn). pp 400-22 of Proceedings of the Heidelberg International Conference on Elementary Particles. Filthuth, H. (ed.). New York, John Wiley and Sons, Inc., 1968.

See CONF-670934.

The review of single pion photoproduction below 1.5 GeV covers new experimental data, dispersion theory for photoproduction around the first resonance, comparison of dispersion theory with experiment, and the phenomenological isobar model for the energy region between 750 and 1450 MeV. Curves showing the differential cross sections, polarization, and asymmetry for the various reactions are given. (J.F.P.)

32090 DOUBLE-PION PHOTOPRODUCTION AND ISOBARIC MODEL BELOW 1 GeV. Giannini, I.; Santroni, A. (Istituto Nazionale di Fisica Nucleare, Genoa. Univ., Genoa). Nuovo Cim., 55A: 359-62(May 21, 1968).

Calculations are made of the final proton distributions in double charged-pion photoproduction in the isobaric model without Adair's approximation. Distributions and mass spectra are obtained which can be used to distinguish the possible P_{11}, D_{13} existence both with bubble chambers and counter spark chamber techniques. The process is assumed to proceed through the following intermediate states $\gamma + p \rightarrow X_{2t,2j} \rightarrow \pi + P_{33}(1236) \rightarrow p + \pi^+ + \pi^-$, where $X_{2t,2j}$ is considered as the $P_{11}(1400)$ or $D_{13}(1525)$. (L.B.S.)

32091 $X^0 - \eta$ MIXING AND RADIATIVE MESON DECAYS. Kanazawa, Akira; Sakuma, Tetsuro (Hokkaido Univ., Sapporo). Progr. Theor. Phys. (Kyoto), 39: 696-701(Mar. 1968).

The two-gamma decay of the η-meson and other related processes are reinvestigated in a simple quark model. It is assumed that the [36] meson states have the same space part of the wave functions, and the η- and X^0-mesons are approximately in the pure nucleon and the lambda quark-antiquark states, respectively. $\Gamma(\eta \rightarrow 2\gamma) = 1.36$ keV is predicted, which is quite consistent with the recent experiment. The predictions on other decay processes are also shown to be compatible with experiment. (auth)

32092 MEASUREMENT OF THE Σ^+ MAGNETIC MOMENT. Mast, Terry S.; Gershwin, Lawrence K.; Alston-Garnjost, Margaret; Bangerter, Roger O.; Barbaro-Galtieri, Angela; Murray, Joseph J.; Solmitz, Frank T.; Tripp, Robert D. (Univ. of California, Berkeley). Phys. Rev. Lett., 20: 1312-14(June 3, 1968).

The Σ^+ magnetic moment was measured and found to be $(2.1 \pm 1.0)\mu_N$ by observing the precession of polarized sigmas in a magnetic field of 18.7 kG. The value is in agreement with SU(3) predictions. (auth)

32093 LEPTONIC DECAYS OF NEUTRAL VECTOR MESONS AND $\rho - \omega$ INTERFERENCE. Parsons, Ronald G.; Weinstein, Roy (Northeastern Univ., Boston). Phys. Rev. Lett., 20: 1314-18(June 3, 1968).

The effect of $\rho - \omega$ interference on the leptonic decay of photoproduced neutral vector mesons is shown to be much larger than previously estimated. The experimental determination of the leptonic branching ratio of the ρ is shown to be sensitive to the amount of interference of the ρ and ω. (auth)

Weak

Refer also to abstract 32663.

32094 (UCID-2885) NEUTRAL $K_{\lambda 3}$ DECAYS. Webber, B. R. (California Univ., Berkeley. Lawrence Radiation Lab.). Nov. 11, 1966. Contract W-7405-eng-48. 6p. Dep. CFSTI.

Neutral K's propagating in free space are best understood as time-dependent superpositions of states which have definite lifetimes. Such time-dependent states may be expressed as linear combinations of the eigenstates and of strangeness. The given initial conditions and the matrix elements may be used to give the time-dependent rate of decay into a π with any type or types of leptons. This will always have the form $\Gamma = Ae^{-\Gamma_s t} + Be^{-\Gamma_L t} + [C\cos(m_s - m_L)t + D\sin(m_s - m_L)t]e^{-\Gamma_s + \Gamma_L/2}t$, where t is the proper time and A, B, C, and D are functions of the form factors. Relevant theoretical predictions are summarized, and A, B, C, and D are exhibited explicitly for the various modes using some simplifying assumptions. (J.F.P.)

32095 MASS DIFFERENCE OF K_S^0 AND K_L^0 MESONS. MASS OF W MESON AND SUM RULES FOR SPECTRAL FUNCTIONS. Gedalin, E. V.; Kancheli, O. V.; Matinyan, S. G. (Inst. of Physics, Tbilisi, USSR). JETP LETT. (USSR) (Engl. Transl.), 7: 136-8 (Mar. 1968).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 7: 178-80(Mar. 5, 1968).

A finite expression for the mass difference of the K_1^0 and K_2^0 mesons is obtained using an approach similar to that of Glaschow, Schnitzer, and Weinberg who obtained a finite expression for the matrix element of the $K2\pi$ decay in second order of weak interaction theory with the intermediate vector boson. It is emphasized that in the calculation the problem of the σ terms is not encountered since they do not appear. (J.F.P.)

32096 CHARGE ASYMMETRY IN K_{e3}^0 DECAYS AND PARAMETERS OF THE $K^0 - \bar{K}^0$ SYSTEM. Chkareuli, Dzh. L. JETP LETT. (USSR) (Engl. Transl.), 7: 141-4(Mar. 1968).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 7: 184-7(Mar. 5, 1968).

It is shown that a previous result for the charge asymmetry in K_{e3}^0 decay does not agree with the experimental values of the other parameters of the $K^0 - \bar{K}^0$ system, and that the previous result for the charge asymmetry in $K_{\mu 3}^0$ decay does not contradict them. The value of the asymmetry parameter is also predicted. (J.F.P.)

32097 DECAY RATE OF THE SHORT LIVED NEUTRAL KAON. Donald, R. A. (Univ. of Liverpool); Edwards, D. N.; Nisar, T.; Barlow, J.; Dobrzynski, L.; Levy, F. Phys. Lett., 27B: 58-60(May 27, 1968).

The mean life of the short lived neutral kaon is found to be 0.856×10^{-10} sec, using a sample of 19,990 events. The mean lives of neutral kaons of known initial strangeness are also measured. (auth)

32098 LEPTONIC DECAY OF THE PION AND THE SPECTRAL FUNCTION SUM RULES. Iwao, Syurei (Tokyo Univ. of Education). Progr. Theor. Phys. (Kyoto), 39: 239-41(Jan. 1968).

The leptonic decay of the pion is investigated under the spectral function sum rules of Weinberg. Although the inclusion of the axial vector meson does not improve the decay parameter numerically, the dynamical nature of the problem is clarified. The whole scheme is shown to be consistent with the approach in the spectral function representation. The pion decay lifetime is found to be $2.604\ (10)^{-8}$ sec, $G_v = 1.03\ (10)^{-5}\ m_v^{-2}$, $\theta_A = 0.256$, and $F_\pi = 1.16 m_\pi$. (J.F.P.)

32099 DIVERGENCE OF CURRENTS. Enkovski, L.; Kukhtin, V. V.; Montvai, I.; Nguyen van Hieu (Joint Inst. for Nuclear Research, Dubna, USSR). Dokl. Akad. Nauk SSSR, 176: 298-300(Sept. 11, 1967). (In Russian).

Recently Weltman proposed relations for the divergences of the vector and axial currents which are a generalization to the case where the electromagnetic and semileptonic weak interactions are taken into account to the first order. He also showed that many sum rules follow from this hypothesis. It is shown that the simultaneous commutative relations of Gell-Mann and the Weltman hypothesis with respect to current divergences are the result of one and the same dynamic model—the quark model. The results of Weltman are generalized to the case where the nonleptonic weak interactions are taken into account. From this generalized hypothesis on current divergences, there also follow directly all the relations between the amplitudes of nonleptonic decays of baryons and mesons obtained earlier by current algebra. (TTT)

32100 ELECTROMAGNETIC INTERACTIONS. Joos, H. (Deutsches Elektronen Synchrotron, Hamburg). pp 349-70 of Proceedings of the Heidelberg International Conference on Elementary Particles. Filthuth, H. (ed.). New York, John Wiley and Sons, Inc., 1968.

See CONF-670934.

A review is given of the theoretical aspects of electromagnetic interactions. The general properties of the electromagnetic current operator, the pion form factor, leptonic decays of vector mesons, photoproduction of vector mesons, and multipion photoproduction are discussed. Also reviewed are the photoproduction of pions at low and medium energies and electromagnetic coupling constants and electromagnetic decays. (J.F.P.)

32101 WEAK INTERACTION THEORY. Wolfenstein, Lincoln (Carnegie-Mellon Univ., Pittsburgh). pp 289-98 of Proceedings of the Heidelberg International Conference on Elementary Particles. Filthuth, H. (ed.). New York, John Wiley and Sons, Inc., 1968.

See CONF-670934.

The present status of weak interaction theory is reported. The discussion covers the theory of CP-conserving weak interactions including only those elements generally agreed on, some open theoretical questions, a summary of the successful applications to processes involving leptons, a brief discussion of nonleptonic decays, and some indications of problems with the theory that require further experimental and theoretical investigations. (J.F.P.)

32102 PARAMETER ξ IN K_{l3} DECAY. Kenny, Brian G. (Rutherford High Energy Lab., Chilton, Eng.). Phys. Rev. Lett., 20: 1217-21(May 20, 1968).

Implications of discrepancies between different experimental determinations of the parameter ξ in K_{l3} decay are discussed. In particular, it is pointed out that (a) the presence of a scalar interaction less than the present experimental upper limit will have a large effect on ξ, and (b) different experimental determination of ξ could be used to test electron-muon universality. (auth)

32103 GAUGE INVARIANCE, PHOTON MASS, AND WEAK INTERACTION OF PHOTONS. Bandyopadhyay, P. (Indian Statistical Inst., Calcutta). Nuovo Cim., 55A: 367-9(May 21, 1968).

It is shown that the weak-interaction property of photons as suggested by Bandyopadhyay introduces an indirect relation between gauge invariance and zero rest mass of photons. The analysis shows that the weak interaction of photons is possible only in the special case where the gauge transformation of the first kind is not an allowed transformation at all; thus it is concluded that photons can interact weakly only with neutrinos. It is also pointed out that the photon-neutrino weak interactions not only requires zero rest mass of photons, but also the zero rest mass of neutrinos. (L.B.S.)

32104 CALCULATION OF THE DECAY WIDTH OF THE RHO-MESON. Saperstein, A. M. (Wayne State Univ., Detroit). Nuovo Cim., 55A: 334-7(May 21, 1968).

The ρ decay width is calculated using the assumptions of PCAC, current algebra, and the universal coupling of the ρ to isotopic currents. The invariant $f_{\rho\pi\pi}$ (p^2, k'^2, k'^2) is evaluated from $f_{\rho\pi\pi}$ (m^2, o, o), which leads to a width $\Gamma \sim 90$ MeV. (L.B.S.)

32105 IMCOMPATIBILITY OF THE QUARK-FIELD $(U_6 \otimes U_6)$ COMMUTATION RELATIONS WITH VECTOR-MESON DOMINANCE IN π^0 DECAY. Barry, G. W. (Univ. of Chicago); Sakurai, J. J. Nuovo Cim., 55A: 326-9(May 21, 1968). (SLAC-PUB-382).

It is pointed out that the quark-field commutation relation is incompatible with vector-meson dominance in π^0 decay. In contrast, it is shown that the commutation relation of the gauge-field algebra is consistent with the high-energy behavior of the vector-meson dominance model and the predictions for the pion lifetime. (L.B.S.)

32106 SU(3), GOLDBERGER–TREIMAN RELATION, AND CABIBBO ANGLE. Nieh, H. T. (State Univ. of New York, Stony Brook). Phys. Rev. Lett., 20: 1254-5(May 27, 1968).

Two implications of the results of the KNΛ and KNΣ coupling constant determinations, which indicate that the trilinear pseudoscalar meson–baryon coupling constants are consistent with exact SU(3) symmetry, and that the F–D mixing parameter of the pseudoscalar meson–baryon vertices, in the form of gradient coupling, agrees very well with the corresponding parameter of the axial vector vertex functions for baryon leptonic decays within the framework of Cabibbo theory, are given. These implications are that the Goldberger–Treiman (GT) relations for the meson (K) decay constant are well satisfied; the degree of their validity is comparable with that of the ordinary GT relation for the pion decay constant, and the empirical relation $\theta_A^{(B)} \simeq \theta_A^{(M)}$, where $\theta_A^{(B)}$ and $\theta_A^{(M)}$ are the phenomenological axial-vector Cabibbo angles for the baryon leptonic decays and pseudoscalar meson decays, respectively can be understood on the basis of the GT relations. (J.F.P.)

32107 $K \rightarrow 3\pi$ DECAYS. Li, Ming Chiang (Virginia Polytechnic Inst., Blacksburg). Nuovo Cim., 55A: 195-8(May 1, 1968).

A model is proposed similar to that proposed earlier for the nonleptonic two-body decays and is capable of describing the amplitude for $K \rightarrow 3\pi$. It is assumed that the $K \rightarrow 3\pi$ decay amplitude can be well represented by the appropriate extrapolation of the amplitude of the multiple pion production. (J.F.P.)

32108 RELATION BETWEEN THE $K^{\pm} \rightarrow \pi^{\pm}\pi^0$ AND THE S-WAVE $\Sigma^+ \rightarrow n\pi^+$ DECAYS. Mathur, V. S. (Univ. of Rochester, N. Y.); Pandit, L. K. Nuovo Cim., 55A: 211-14(May 1, 1968).

The possibility that the weak Hamiltonian contains an intrinsic $\Delta I = 3/2$ piece and that the $\Delta I = 1/2$ effects are dynamically enhanced in a physical process is explored. Also the $\Delta I = 3/2$ effects in kaon and hyperon nonleptonic decays are related. An extension of a model proposed previously which related the $\Delta I = 1/2$ effects in the $K \rightarrow 2\pi$ and the S-wave $Y \rightarrow N\pi$ decays is employed. In this model one assumes that the octet part of the parity-violating weak Hamiltonian behaves as a member of an octet of pseudoscalar densities and the lowest-order medium-strong mass-splitting Hamiltonian is a member of an octet of scalar densities, such that the two octets of pseudoscalar and scalar densities belong to the $(8,1) \oplus (1,8)$ representation of $SU(3) \oplus SU(3)$. (J.F.P.)

32109 FORM FACTORS OF RADIATIVE DECAYS OF CHARGED KAONS. Namaizawa, Hiroshi (Tokyo Univ.). Progr. Theor. Phys. (Kyoto), 39: 860-2(Mar. 1968).

A zero energy theorem for the structure dependent vector form factor $a(\nu)$, $\nu \equiv kq$ in the $K^-(k) \rightarrow l^-(p_1) + \bar{\nu}(p_2) + \gamma(q)$ decays. The soft-kaon technique and chiral SU(3) × SU(3) current algebra are used. The photon energy spectra are calculated, and the partial rates $W(K \rightarrow e\nu\gamma)/W(K \rightarrow e\nu) = 1.51 \times 10^{-1}$ and $W(K \rightarrow \mu\nu\gamma)/W(K \rightarrow \mu\nu) = 7.93 \times 10^{-3}$ are obtained. (L.B.S.)

32110 IS ONE OF THE LEPTON QUANTUM NUMBERS MULTIPLICATIVE? Nguyen Van Hieu; Pontecorvo, B. (Joint Inst. for Nuclear Research, Dubna, USSR). JETP Lett. (USSR) (Engl. Transl.), 7: 105-7(Feb. 20, 1968).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 7: 137-9(Feb. 20, 1968).

An experimental study of the decays $\mu^+ \rightarrow e^+ + \nu_e + \bar{\nu}_\mu$ and $\mu^+ \rightarrow e^+ + \bar{\nu}_e + \nu_\mu$ is proposed to verify the existence of a multiplicative lepton number. (L.B.S.)

32111 CONCERNING (V + A) CURRENTS IN WEAK INTERACTIONS OF ELEMENTARY PARTICLES. Lipmanov, E. M.; Mikheev, N. V. (Volgograd Pedagogical Inst., USSR). JETP Lett. (USSR) (Engl. Transl.), 7: 107-9(Feb. 20, 1968).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 7: 39-42(Feb. 20, 1968).

A study is made of the effect of (V + A) currents in the exact form of the spectrum and angular correlations of μ-decay electrons in the entire range of momentum variation, from $p = o$ to $p = p_{max}$. (L.B.S.)

32112 PHENOMENOLOGICAL MODEL FOR π AND K MESON DECAYS. Konno, Kimiaki (Nihon Univ., Tokyo). Progr. Theor. Phys. (Kyoto), 39: 702-10(Mar. 1968).

A phenomenological model for π- and K-meson semileptonic decays is proposed. An effective Lagrangian is constructed. This structure is expressed by the effective strong interaction Lagrangian except for one overall coupling constant which characterizes weak interaction. It is found that the strength of weak interaction is smaller than that of strong interaction by an order 10^{-7} and is also found that the two Cabibbo angles characteristic of the vector (θ_V) and axial vector (θ_A) currents are determined by the pseudovector coupling constants f_π and f_K and g_A/g_V ratios for πN and KN scattering. It is predicted that the probability of the strangeness conserving neutral K-meson decay, $\bar{K}^0 \rightarrow K^- + e^+ + \nu_e$, is two orders of magnitude lower than that of the Cabibbo theory. Finally, relation of π- and K-meson masses to the coupling constants of strong and weak interactions is also discussed. (auth)

32113 WEAK RADIATIVE DECAYS OF HYPERONS AND PARTIALLY CONSERVED TENSOR CURRENT. Hosoda, Masataka; Ozaki, Kazuhiko (Osaka Univ.). Progr. Theor. Phys. (Kyoto), 39: 711-16(Mar. 1968).

Weak radiative decays of hyperons are examined under the assumptions: (a) weak decays occur through scalar-pseudoscalar weak interaction and (b) partially conserved tensor current (P.C.T.C.) hypothesis. The branching ratio for $\Sigma^+ \rightarrow p + \gamma$ is obtained using the same values of parameters as those for pionic hyperon decays. Our estimated value, (1.79×10^{-3}) is in good agreement with the experimental one, $(1.9 \pm 0.4) \times 10^{-3}$. It is emphasized that the contribution of the commutator term is very important and some of the pole terms are rather suppressed. These are very different points of our model from those of other models. Discussions are also given for the decays of other hyperons. (auth)

32114 STUDY OF THE VALIDITY OF A MODEL OF VECTOR BOSONS WITH LEPTONIC DECAY MODES. Andriambololona, Raoelina; Bourrely, Claude (Centre de Physique Theorique, Marseille). Compt. Rend., Ser. A and B, 266: 361-3(Feb. 12, 1968). (In French).

The theoretical results concerning the lepton decay ($\mu^+\mu^-$ and e^+e^-) of the vector mesons ρ^0 and Ω^0 are reported. The vector mesons were treated in the framework of a model composed of strong interactions. (tr-auth)

Strong (General)

Refer also to abstract 32219.

32115 PRE-ASYMPTOTICAL BEHAVIOR OF CROSS SECTIONS. Akimov, V. N.; Dremin, I. M.; Roizen, I. I.; Chernavskii, D. S. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz., 7: 629-34(Mar. 1968). (In Russian).

The dependence of the cross sections of strong interaction processes on the energy is studied by means of the recently developed method based on the Bethe–Salpeter equation. It is shown that there is a connection between the values of cross sections at low energies on the one hand, and at very high energies, on the other. In the intermediate region which can be considered as a pre-asymptotical one, a small increase of the cross section could be expected. (auth)

32116 PION FORM FACTOR AND $\pi\pi$ DIFFRACTION CROSS SECTION FROM CONSISTENCY RELATIONS AMONG pp, $p\bar{p}$, πp, AND $\pi\pi$ DIFFRACTION CROSS SECTIONS. Shrauner, E. (Washington Univ., St. Louis). Phys. Rev. Lett., 20: 1258-60(May 27, 1968).

Consistency relations among pp, $p\bar{p}$, πp, and $\pi\pi$ diffraction scattering cross sections and the pion and nucleon form factors are derived on the basis of the multiple-quark-scattering picture of elastic scattering of hadrons. The pion form factor is found to be similar to the nucleon form factor and the charge radius of the pion is $r_\pi \cong 0.65$ F in agreement with experimental evidence. The differential cross section for $\pi\pi$ diffraction scattering is found to be $^4/_9$ times that of πp. (auth)

32117 COMPOSITENESS AS A CLUE FOR THE UNDERSTANDING OF THE ASYMPTOTIC BEHAVIOR OF FORM FACTORS. Amati, D. (CERN, Geneva); Jengo, R.; Rubinstein, H. R.; Veneziano, G.; Virasoro, M. A. Phys. Lett., 27B: 38-41(May 27, 1968).

An inverse power behavior of the form factors is obtained when the hadrons are considered as composite systems described by a relativistic ladder. A "scale-law" for different form factors and the dependence on the spin of the hadron is established. (auth)

32118 DEFORMABLE SPHERE MODEL OF ELEMENTARY PARTICLES AND ITS RELATION TO QUARK. Hara, Osamu; Goto, Tetsuo; Tsai, S. Y.; Yabuki, Haruichi (Nihon Univ., Tokyo). Progr. Theor. Phys. (Kyoto), 39: 203-27(Jan. 1968).

A deformable sphere model of elementary particles is discussed as a generalization of the rigid body model. It is shown that the ground state and the low lying levels of such a sphere can be described in terms of excitons which describe the rotation and the deformation of the system. As far as the spin and the unitary spin quantum numbers are concerned, these excitons can be identified with the quark and the antiquark. In contrast to the conventional quark, however, they obey the Bose-statistics and have mass about one third of the nucleon mass. Further in this model it can be shown that the triality is restricted to zero. Therefore, particles with fractional electric charge or fractional baryonic number do not appear. Thus, this model eliminates most of the difficulties of the conventional quark model, and it is shown that as far as the low lying levels of the hadrons are concerned, the elementary particles can be understood consistently as the excited state of a deformable sphere. Discussions are restricted to the uniform deformations and is done in the nonrelativistic approximation. (auth)

32119 ALGEBRA OF FIELDS AND PHENOMENOLOGICAL LAGRANGIANS. Zumino, Bruno (New York Univ.). pp 465-75 of Proceedings of the Heidelberg International Conference on Elementary Particles. Filthuth, H. (ed.). New York, John Wiley and Sons, Inc., 1968.

See CONF-670934.

The physics of hadrons is considered in two approaches—that of the algebra of fields and that of phenomenological Lagrangians. The relation between these two approaches is also discussed with restriction to the case of the chiral SU(2) × SU(2). (J.F.P.)

32120 THEORETICAL ASPECTS OF HIGH ENERGY PHENOMENOLOGY. Bertocchi, L. (CERN, Geneva). pp 197-250 of Proceedings of the Heidelberg International Conference on Elementary Particles. Filthuth, H. (ed.). New York, John Wiley and Sons, Inc., 1968.

See CONF-670934.

Regge pole theory for hadron interactions is reviewed. This review covers the Reggeization of helicity amplitudes, the dip mechanism, Regge poles and SU(3) symmetry, and large angle scattering. Also reviewed are backward scattering, the double Regge exchange model for three-body final states, coherent scattering, and production on light nuclei. (J.F.P.)

32121 EXPERIMENTAL ASPECTS OF INTERMEDIATE AND HIGH-ENERGY COLLISIONS. Di Lella, L. (CERN, Geneva). pp 159-96 of Proceedings of the Heidelberg International Conference on Elementary Particles. Filthuth, H. (ed.). New York, John Wiley and Sons, Inc., 1968.

See CONF-670934.

A number of recent experimental results obtained in the study of hadron-hadron collisions at incident laboratory momenta $p_{lab} \gtrsim 2$ or 3 GeV/c are reviewed. Processes leading to quasi-two-body final states are mainly considered; and some recent developments in the study of collisions giving rise to multiple production of particles are briefly discussed. (auth)

32122 SEMI-RELATIVISTIC EQUATION FOR QUARK–ANTIQUARK SYSTEMS. Fischer, J.; Limic, N.; Niederle, J.; Raczka, R. (International Atomic Energy Agency, Trieste, Italy). Nuovo Cim., 55A: 33-58(May 1, 1968).

The Schrödinger-like relativistic equation for bound states of the two-fermion system is considered. The general properties of solutions and spectra of such equations are derived. The equation is applied for a description of the q-$\bar{q}$ system with arbitrary spin. Using the square-well potential and two ways of symmetry breaking, the equation obtained for the q-$\bar{q}$ system is solved for pseudoscalar-octet mesons. (auth)

32123 BOUND STATE PROBLEM OF DIRAC PARTICLES IN CONNECTION WITH THE NON-RELATIVISTIC QUARK MODEL. Nagasaki, Masayuki (Rikkyo Univ., Tokyo). Progr. Theor. Phys. (Kyoto), 39: 848-50(Mar. 1968).

The requirement of continuity imposed on the wave function in a previous analysis of the bound state problem of Dirac particles is discussed in connection with conclusions reached by Koide and Yamada (Prog. Theor. Phys. 37: 1337(1967)). The case of 0^--meson composed of an urbaryon and an anti-urbaryon of equal mass is considered. (L.B.S.)

32124 REMARKS ON "SEMIRELATIVISTIC QUARK MODEL FOR MESONS." Nagasaki, Masayuki (Rikkyo Univ., Tokyo). Progr. Theor. Phys. (Kyoto), 39: 854-6(Mar. 1968).

A discussion is given on a recent paper by Horwitz (Phys. Rev. 161: 1415(1967)) concerning the bound-state problem of a Dirac particle interacting with an anti-Dirac particle through a potential. (L.B.S.)

32125 QUARK MODEL FOR BARYONS AND RESONANCES. Mitra, A. N. (Univ., Delhi). pp 131-8 of Symposia on Theoretical Physics and Mathematics. 7. Ramakrishnan, Alladi (ed.). New York, Plenum Press, 1968.

A quark model for the structure of baryons and their resonances is presented, and an attempt is made to apply this model to physical processes such as the strong decay of baryon resonances, meson–baryon scattering, and photoproduction of pseudoscalar mesons. The basic assumptions are the specification of the statistics for quarks and the nature of the forces. Only the most economical model of Gell-Mann and Zweig is considered. (J.F.P.)

Strong (Baryon No. = 0)

Refer also to abstract 32114.

32126 SELF-CONSISTENT COUPLINGS OF THE 1^- AND 2^+ NONETS TO THE 0^- MESONS. Schmid, C.; Yellin, J. (Univ. of California, Berkeley). Phys. Lett., 27B: 19-22(May 27, 1968).

The PP → PP scattering ($P = 0^-$ mesons) is studied, using finite-energy sum rules to compute the couplings PPV and PPT of the 1^- and 2^+ nonets. Taking degenerate masses for each J^P, it is shown that the existence of the observed resonances is consistent with the equations, and it is proved that the observed 0^-, 1^-, and 2^+ multiplets must have SU(3) symmetric couplings. In addition, it is shown that self-consistency requires a definite ratio of singlet 1 octet coupling for the 2^+ nonet. The observed masses are then used to compute the broken couplings. Numerical results are given for the three independent systems: $(\pi\pi \rightarrow \pi\pi)$; $(k\pi \rightarrow k\pi;\ \bar{k}k \rightarrow \pi\pi)$; $(kk \rightarrow kk;\ \bar{k}k \rightarrow kk)$. (L.B.S.)

32127 VECTOR AND AXIAL VECTOR MESONS AND CHIRAL CURRENT ALGEBRA. Shiozaki, Takanori (Nagoya Univ., Japan). Progr. Theor. Phys. (Kyoto), 39: 189-94(Jan. 1968).

As the chiral partners of vector gauge mesons the axial vector mesons are introduced by the generalization of the Yang-Mills theory. The connection to the chiral current algebra with these vector and axial vector fields is discussed. (auth)

32128 CLASSIFICATION OF HIGHER BOSON RESONANCES. Okada, Kunihiko (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto), 39: 230-1(Jan. 1968).

A classification of the R, S, T, and U mesons is obtained by adopting not only the spin–orbit but also the spin–spin force, which does not break the success of the 1P state of $(t\bar{t})$. The energy levels of the $(t\bar{t})$ system and the classification of higher boson resonances are shown. (J.F.P.)

32129 LOW ENERGY BEHAVIOR OF THE π-π PHASE SHIFTS. Yabuki, Haruichi (Tokyo Univ.). Progr. Theor. Phys. (Kyoto), 39: 118-25(Jan. 1968).

The behavior of the S-wave π-π scattering phase shifts at low energies is investigated in terms of the forward dispersion relations. The main conclusions are: The experimental data of Walker et al. give a set of values $a_0 \approx 0.26\ m_\pi^{-1}$ and $a_2 \approx -0.07\ m_\pi^{-1}$ with $a_0/a_2 \approx -\frac{1}{2}$ as one possible solution. They support the existence of a zero below threshold in the $I = 0$ S-wave amplitude. (auth)

32130 S-WAVE $\pi\pi$ SCATTERING WITH SMALL SCATTERING LENGTHS. Fujii, Yasunori; Hayashi, Koichi (Tokyo Univ.). Progr. Theor. Phys. (Kyoto), 39: 126-31(Jan. 1968).

It is shown that the small $\pi\pi$ scattering lengths as predicted by current algebra can be well consistent with the recent $\pi\pi$ phase shift analysis, the forward dispersion relation and the sum rule for the axialvector coupling constant, if one properly takes into account a zero in each of the S-wave amplitudes. (auth)

32131 SCATTERING LENGTHS FOR COMPLEX ANGULAR MOMENTA. Ida, Masakuni; Yabuki, Haruichi (Tokyo Univ.). Progr. Theor. Phys. (Kyoto), 39: 151-65(Jan. 1968).

Some general properties of the scattering length as a function of complex angular momenta are studied. A product representation is introduced for it under the assumption that it is a meromorphic function of order less than 2. Possible existence of a new vacuum trajectory is discussed in connection with the $I = 0$ π-π S-wave scattering length. (auth)

32132 A NEW DETERMINATION OF THE REGGE PARAMETERS. Grecchi, V. (Univ., Florence. Scuola di Perfezionamento in Fisica, Bologna); Minguzzi, A.; Salvini, M. Nuovo Cim., 55A: 349-53(May 21, 1968).

A discussion is presented of inverse dispersion relations and mixed dispersion relations in which the p, p′, and ρ residues and intercepts are present, in the form of subtractions performed at infinity. The Regge parameters for π-N scattering are determined and are tabulated. (L.B.S.)

32133 DYNAMICS OF THE $K\pi\pi$ RESONANCES. Nakamura, Yoshiko Oi (Tokyo Univ.). Progr. Theor. Phys. (Kyoto), 39: 690-5(Mar. 1968).

The Peierls mechanism is applied to the $K\pi\pi$ system. Then generalization of the Peierls mechanism to the ladder diagram is made on the basis of the Faddeev-Lovelace formalism. The problem discussed is whether the resonant peaks appear in eigenchannels with definite quantums (I,J^P). They are found in certain channels in our approximation and their possible assignments to the experimentally observed resonances is discussed. (auth)

32134 SHIFT IN THE POMERANCHUK INTERCEPT DUE TO ELECTROMAGNETISM. Buccella, F. (Univ., Florence. Univ., Rome); Celeghini, E.; Srivastava, Y. Nuovo Cim., 55A: 27-32 (May 1, 1968).

The change in the intercept at $t = 0$ of the Pomeranchuk trajectory due to e.m.i. in the hypothesis that in their absence this value is one. It is found that $\Delta\alpha_p(0) \approx -0.06$ in good agreement with what comes out from successful fits to high-energy reactions. The technique employed to obtain such a result is the standard Dashen-Frautschi method. It is applied to the pion-pion scattering. (auth)

32135 VECTOR-MESON DOMINANCE IN THE CABIBBO THEORY OF WEAK INTERACTIONS. van der Merwe, P. du T. (Atomic Energy Board, Pelindaba, South Africa). Nuovo Cim., 55A: 193-4(May 1, 1968).

It is pointed out that the same coupling constant relation, as that previously found using a conserved weak SU(3) current and assuming a vector-meson dominance model for the vector meson–lepton–neutrino coupling constant, results in the Cabibbo theory provided that the vector electromagnetic form factors are dominated by vector meson exchange for low momentum transfer and that the vector mesons are coupled universally to the hadron currents according to the hypothesis of Sakurai. Furthermore the universality of the Cabibbo angles describing the weak vector currents follows from the analysis. (J.F.P.)

32136 ARE THERE THREE VACUUM TRAJECTORIES. Johnson, R. C. (Univ. of Durham, Eng.). Nucl. Phys., B5: 673-82(1968).

Recent experiments suggest the existence of a $I^G = 0^+$, $J^P = 2^+$ meson of mass 1085 MeV. Consequently the existence of three high-lying Regge trajectories with vacuum quantum numbers is proposed. A qualitative comparison of this hypothesis with elastic scattering measurements is favorable, and underlines the importance of acquiring further data on the new resonance. (auth)

32137 ESTIMATES OF REGGE-CUT EFFECTS. Freund, Peter G. O.; O'Donovan, Patrick J. (Univ. of Chicago). Phys. Rev. Lett., 20: 1329-32(June 3, 1968).

In inelastic channels (charge exchange, etc.) at $t = 0$, moving-cut effects are found to be $\lesssim 5\%$ of the Regge-pole effects. This result is based on a dynamical approximation. Our findings clarify the success of relations among total cross sections derived by taking into account Regge poles alone. (auth)

32138 TWO-BODY BOUND STATE PROBLEM OF DIRAC PARTICLES. Koide, Yoshio (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto), 39: 817-29(Mar. 1968).

Concerning the composite model of mesons, the two-body problems of Dirac particles interacting through a potential are studied using the Dirac equation. Independently of the shape of the potential and the type of the interaction, it is concluded that the masses of the composite particles with $J^P = 1^-, 2^+, 3^-, \ldots$ cannot be smaller than $M \equiv (m_1 + m_2)/2$ in the case $m_1 \neq m_2$, where the m_1 and m_2 are the masses of the constituents. The comment for the existence of this lower limit is also given in brief. (auth)

32139 UNITARY-SYMMETRICAL STATISTICAL MODEL OF MULTIPLE PARTICLE PRODUCTION. Barashenkov, V. S.; Maltsev, V. M.; Zinov'ev, G. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Pol., 33: 315-25(Feb. 1968).

A statistical model is suggested in which particles are considered as the terms of SU(3) multiplets and transitions are possible only between states corresponding to the identical irreducible representations of the group SU(3). The processes of $p\bar{p}$ and $\bar{p}n$ annihilation at rest and the inelastic $\pi^{\pm}P$ interactions in the energy range $T > 1$ GeV are considered in detail. Introducing the splitting of the effective coupling constant which is due to the difference between the interactions of the K-mesons and other particles, a disagreement with experiment occurs only for channels with a small number of particles where a more detailed approach is needed. (auth)

32140 COUPLINGS OF PARTICLES BY MEANS OF SUPERCONVERGENCE. Bishari, M.; Schwimmer, A. Y. (Weizmann Inst. of Science, Rehovoth, Israel). Nucl. Phys., B5: 641-56 (1968).

A study of the analyticity constraints on the reaction $\pi\rho \rightarrow \pi\rho$ assuming saturation by means of resonances and Regge trajectories is undertaken. New features include the introduction of $I = 0$ t-channel sum rules by using the trick of Ademollo et al., and the search of a solution to all (superconvergent and Igi-type) sum rules for a range of t. A unique solution is found that demands $g_T(A_1) \approx 0$ and $g_T(H) \approx (m_H/m_\rho)g_L(H)$ (if H exists). The recently reported 2^- particle is included, which seems to be necessitated for a good saturation in a range of t. The former existing solutions are discussed and an $I = 0$ current-algebra sum rule is studied that lends support to our result. (auth)

Strong (Baryon No. = 1)

Refer also to abstract 32139.

32141 (INP–592/PH) THE DECOUPLET EXCHANGE SUPERCONVERGENCE RELATIONS FOR MESON–BARYON SCATTERING AND CUTS IN THE COMPLEX J PLANE. Kwiecinski,

J. (Institute of Nuclear Physics, Krakow (Poland)). 1968. 10p. Dep.

The possible superconvergence relations are studied for that part of the meson–baryon scattering amplitude which corresponds to the exchange of the decouplet in the t-channel. It was found that the superconvergence relations cannot be satisfied by the respective two invariant amplitudes separately but only by their combination, which for $t = 0$ corresponds to the forward scattering amplitude. This fact is explained in terms of cuts in the complex j-plane. (auth)

32142 (UCID-2752) REMARKS ON THE p $\pi^+\pi^+$ ENHANCEMENT AT 1560 MeV. Dash, J.; Goldhaber, G., Swihart, J. (California Univ., Berkeley. Lawrence Radiation Lab.). Sept. 13, 1965. Contract W-7405-eng-48. 21p. Dep. CFSTI.

A Monte Carlo calculation which was carried out in an attempt to analytically reproduce the structure of the $p\pi^+\pi^+$ enhancement at 1560 MeV in the $\pi^+ + p \to \pi^+ + \pi^- + \pi^+ + p$ interaction is described. The possibility that a model involving peripheral production of ρN^*, and including Bose symmetrization, could lead to an enhancement in the $p\pi^+\pi^+$ system is investigated. Several approximations to the model were employed in the calculations in addition to the correctly calculated model. It was found that some of the differential cross sections calculated with the correct weight disagree with the experimental data. The introduction of a simple form factor yields qualitative agreement with the data. (J.F.P.)

32143 (UCID-3163) SCATTERING AMPLITUDES, PARTIAL WAVES, RESONANT STATES, AND PRODUCTION AND POLARIZATION ANGULAR DISTRIBUTIONS. Wohl, Charles (California Univ., Berkeley. Lawrence Radiation Lab.). Mar. 8, 1966. Contract W-7405-eng-48. 14p. Dep. CFSTI.

The amplitude of meson–baryon scattering is considered. Spin-0 mesons and spin-½ baryons are treated. The nonspin-flip and spin-flip amplitudes can be expanded in terms of partial-wave amplitudes each with given orbital angular momentum, parity, and total angular momentum. The elastic and inelastic partial-wave amplitudes are shown schematically. Although in general the partial-wave amplitude variation with energy is unknown, in the vicinity of a resonance the corresponding partial-wave amplitude has the Breit–Wigner form. The partial-wave expansion coefficients are tabulated for scattering in a state of pure isospin. A cross section completely described by n numbers denotes 2n unknown quantities. Polarization data provide additional constraints. Unless there is very complete and accurate data, any attempt to fully analyze the scattering amplitudes must reduce the number of free parameters. The number of unknowns is further multiplied by the number of isospin states that contribute to the reaction. (J.F.P.)

32144 ENERGY BEHAVIOR OF PARTIAL d WAVES IN πN SCATTERING. Lendel, V. I.; Marina, D. M. (Uzhgorod State Univ., USSR). Yadern. Fiz., 7: 635-43(Mar. 1968). (In Russian)

By means of the forward scattering dispersion relations and taking into account the high-energetic contributions, the expressions for d waves of the πN scattering are obtained. The partial waves obtained are in good agreement with the experimental data up to the energy 500 MeV. (auth)

32145 DETERMINATION OF ISOBAR AMPLITUDES IN THE $\pi^-p \to \pi^+\pi^-n$ REACTION AT THE ENERGIES 360 AND 430 MeV. Makarov, M. M.; Sarantsev, V. V. (Ioffe Inst. of Physics and Tech., Leningrad). Yadern. Fiz., 7: 590-5(Mar. 1968). (In Russian).

The isobar amplitude and the phase shift between the background and the isobar amplitudes are determined for the $\pi^-p \to \pi^+\pi^-n$ reaction at energies 430 and 360 MeV, using the relativistic Breit–Wigner formula for the (3/2, 3/2)-isobar production and with the statistical distribution for the background. The isobar production cross section for these energies equals to 1.75 ± 0.70 and 0.36 ± 0.22 mbarn, respectively. (auth)

32146 LOW ENERGY PION–NUCLEON PHASE SHIFTS FROM A PADE APPROXIMANTS' APPROACH. Remiddi, E. (CERN, Geneva); Pusterla, M.; Mignaco, J. A. Phys. Lett., 27B: 34-7(May 27, 1968).

In the framework of the Padé approximants' technique, a parametrization for low energy πN elastic scattering is given. A fit of the corresponding phase shifts up to 1600 MeV of c.m.s. energy is discussed. (auth)

32147 REGGE POLES, ARGAND DIAGRAMS, AND INELASTIC RESONANCES. Collins, P. D. B.; Johnson, R. C.; Squires, E. J. (Univ. of Durham, Eng.). Phys. Lett., 27B: 23-6(May 22, 1968).

Partial-wave projections of Regge pole amplitudes are discussed, and it is shown that circles in Argand diagrams are freely produced. It is argued that these should not be interpreted as resonances, and hence that the determination of resonances by phase-shift analyses is questionable. (auth)

32148 VACUUM EXCHANGE AMPLITUDES FROM A FAMILY OF SUM RULES. Barger, V. (Univ. of Wisconsin, Madison); Phillips, R. J. N. Contract AT(11-1)-881. Phys. Lett., 26B: 730-2(May 13, 1968). (COO-881-152).

The properties of vacuum-exchange amplitudes in high-energy πN scattering are deduced from a family of generalized superconvergent sum rules, through a range of t. The t-channel nonflip amplitude A'^+ agrees with some $P + P'$ Regge pole models, preferring the "no-compensation" mechanism. The t-channel flip amplitude B^+ differs in size and sign from what has normally been assumed. The sum rules suggest an approximate relation $\nu B^+ \approx A'^+$. A Regge pole fit to data including this ansatz gives good agreement with the A'^+ sum rule, and semi-quantitative agreement with B^+ sum rules. (auth)

32149 PHENOMENOLOGICAL DYNAMICS OF STRONG INTERACTION WITH PARTIAL CHIRAL SYMMETRY. Shiozaki, Takanori (Nagoya Univ., Japan). Progr. Theor. Phys. (Kyoto), 39: 195-202(Jan. 1968).

The phenomenological strong interaction Lagrangian with chiral $U(3) \times U(3)$ symmetry and PCAC is constructed. The universal interaction with vector and axial vector mesons are also introduced by generalizing the Yang-Mills theory. (auth)

32150 EXCHANGE CURRENT AND DECAYS OF DECUPLET BARYONS IN THE QUARK MODEL. Kobayashi, Tsunehiro (Waseda Univ., Tokyo); Konno, Kimiaki. Progr. Theor. Phys. (Kyoto), 39: 182-8(Jan. 1968).

Contributions of the meson exchange currents to the decays of the decuplet baryons are considered in the quark model along a previous line of thought in which the exchange magnetic moment is considered, and the coupling constant $G_{qq\pi}$ is determined from low energy πN scattering, assuming the "additivity" property of the coupling constant in terms of constituent quarks. This coupling constant has the difficulty that the decay width $\Gamma(N^*_{33} \to N\pi)$ is smaller than the experimental one. Then, by introducing the meson exchange currents between quarks, it is shown that $\Gamma(N^*_{33} \to N\pi)$ and $\Gamma(Y^*_1 \to \Lambda\pi)$ and the ratio of $\Gamma(Y^*_1 \to \Sigma\pi)$ to $\Gamma(Y^*_1 \to \Lambda\pi)$ shift toward a good direction. It is also shown that the "additivity" property of the constituent quarks in the baryon still holds in the low-energy strong interaction even in the presence of the exchange currents, because their contributions are small. (auth)

32151 NUCLEON RESONANCES AND LOW ENERGY SCATTERING. Lovelace, C. (CERN, Geneva). pp 79-116 of Proceedings of the Heidelberg International Conference on Elementary Particles. Filthuth, H. (ed.). New York, John Wiley and Sons, Inc., 1968.

See CONF-670934.

The review of nucleon resonances and low-energy scattering includes nucleon–nucleon scattering with meson exchange, and the production of various nucleon resonances, pion–nucleon scattering including the backward amplitude, dispersion relations, phase shift, the Breit–Wigner formula predictions, and Argand diagrams. The nucleon resonances are ordered and their phases shown. (J.F.P.)

32152 MESONS. Butterworth, Ian (Imperial Coll. of Science and Tech., London). pp 11-76 of Proceedings of the Heidelberg International Conference on Elementary Particles. Filthuth, H. (ed.). New York, John Wiley and Sons, Inc., 1968.See CONF-67093

See CONF-670934.

Meson research is reviewed. This review includes 0^-, 2^+, 1^+ mesons, K^* resonances, heavy nonstrange mesons, scalar mesons, observation of the meson (ρ), and the nonrelativistic quark model. Experimental results are briefly described, and cross sections, mass distributions, and Dalitz plots are shown for these experiments. (J.F.P.)

32153 SATURATION OF SUPERCONVERGENCE RELATIONS FOR MESON–BARYON SCATTERING. Miyamura, Osamu; Takagi, Fujio (Tohoku Univ., Sendai). Progr. Theor. Phys. (Kyoto), 39: 132-50(Jan. 1968).

The superconvergence relations are assumed to hold for the meson(P)-baryon(B) forward scattering amplitudes subtracted by the Regge asymptotic terms. The consequences of the assumption that the imaginary parts of the amplitudes at low energy are approximately saturated by the $\frac{1}{2}^+$ octet (B) and the $\frac{3}{2}^+$ decuplet (D) pole contributions are investigated in the framework of the exact SU(3) symmetry. The amplitudes at high energy are assumed to be dominated by the contributions from the exchanges of the Pomeranchuk, tensor octet (T) and vector octet (V) trajectories. Under these assumptions, the consideration of the amplitudes $B^{(+)}(\nu)$ and $M^{(-)}(\nu)$ leads to a set of seven algebraic relations (sum rules) between eight coupling parameters, which can be solved in terms of the BBP coupling constant. Therefore if the experimental values of $g^2_{NN\pi}$ and the degenerate masses (mean masses) of D, B and P are employed, the remaining parameters are completely determined. The results for the BBP and the DBP coupling constants agree with the characteristic features of experiments and some part of them just reduces to the SU(6) predictions in an appropriate limit. However, most of the results for high energy parameters are in bad agreement with experiment. On the other hand, it is pointed out that the superconvergence relations for the amplitudes $M^{(+)}(\nu)/\nu$ in the same approximation lead to a set of four algebraic relations which has no nontrivial solution provided that the values of $M^{(+)}(0)$ are approximately given by Adler's consistency condition. It should be noted that one does not take into account the Regge pole exchange contribution to the imaginary part of the amplitude at low energy. In connection with this point, the way of decomposing the amplitude into the direct pole term and the Regge asymptotic term is discussed in the light of the superconvergence relations. (auth)

32154 DETERMINATION OF COUPLING CONSTANTS FROM POLES IN SCATTERING CROSS SECTIONS. Cutkosky, R. E.; Deo, B. B. (Carnegie-Mellon Univ., Pittsburgh). Phys. Rev. Lett., 20: 1272-5(May 27, 1968).

An optimally convergent polynomial expansion was used in determining the residues of pion and $\Lambda + \Sigma$ poles from n-p and K^+-p differential scattering cross sections. A new method of conservatively estimating the uncertainty is also described. (auth)

32155 ON THE MECHANISM OF THE DOUBLE π-MESON CHARGE EXCHANGE ON NUCLEI AND ON THE EXISTENCE OF "ISONUCLEI." Dalkarov, O. D.; Shapiro, I. S. (Inst. for Theoretical and Experimental Physics, Moscow). Phys. Lett., 26B: 706-9(May 13, 1968).

The mechanism of double charge exchange of pions on nuclei involving a virtual nucleon isobar is considered. The differential cross section of the process is calculated as function of the momentum transfer and of the excitation energy of residual nucleus. The possibility of production of an "isonucleus" in final states is taken into account. (auth)

32156 SUPERCONVERGENCE RELATIONS AND REGGE PARAMETERS. Phillips, R. J. N. (Atomic Energy Research Establishment, Harwell, Eng.). pp 442-5 of Proceedings of the Heidelberg International Conference on Elementary Particles. Filthuth, H. (ed.). New York, John Wiley and Sons, Inc., 1968. See CONF-670934.

A review is given for superconvergence relations and Regge parameters for various interactions. These interactions are the πN interactions at t = 0, for fixed t < 0, and for fixed u (backward scattering), KN interactions, the T = 1 exchange, and double helicity-flip amplitude in $\pi\rho$, πK^*, and $K\rho$ scattering. The interference model is also considered. (J.F.P.)

32157 NEW METHOD OF HIGH ENERGY JET SHOWER ANALYSIS. RELATIVE FOUR MOMENTUM BETWEEN SECONDARY MESONS. Shibata, T.; Hasegawa, S. (Waseda Univ., Tokyo). Uchusen Kenkyu (Tokyo), 12: No. 1, 7-42(July 1967).

The correlation of secondary particles was studied by introducing the relative four momentum $\delta^2_{i,j}$ and several important physical quantities were obtained. The results revealed strongly the existence of the H-quantum, and the agreement of the two $\sqrt{|\delta^2|}$-spectra in the emulsion stack and emulsion chamber data showed that the H-quantum plays an important role in multiple meson production in the wide-energy region, 10^{11} to 10^{14} eV. For the energy region of the accelerator, ~10^{10} eV, an analysis by a similar method is being planned. While large-family events in emulsion chamber data are now increasing, these events will be analyzed in the future. (NSA of Japan)

32158 THE REACTION $K^-p \rightarrow \Lambda\eta$ IN THE MODIFIED EXCHANGE MODEL. Seth, V. P.; Agarwal, B. K. (Univ. of Allahabad, India). Nuovo Cim., 55A: 323-5(May 21, 1968).

Angular distributions for $K^-p \rightarrow \Lambda\eta$ are calculated at 1.22, 1.51, and 1.7 GeV/c, using a modified exchange model in order to investigate the contributions of a combination of K^* and n exchange Born amplitudes and Y_0^* resonance Breit-Wigner amplitude. The agreement between the calculated curves and the experimental data gives confidence in the validity of the model. (L.B.S.)

32159 THE D_{13} $D_{13}\pi$ COUPLING CONSTANT AND THE ADLER-WEISBERGER SUM RULES. Ragusa, S. (Instituto de Fisica Teorica, Sao Paulo, Brazil). Nuovo Cim., 55A: 330-3(May 21, 1968).

The D_{13} decay widths and coupling constants for $Dp\pi^0$, $D^+N^{*++}\pi^-$, and $D^+D^+\pi^0$ are determined using the method of Fubini, et al., for obtaining the Adler-Weisberger relation. (L.B.S.)

32160 PCAC CONSTRAINT FOR $\pi^- + p \rightarrow \mathcal{N}^{*-} + \pi^+$. Singh, C. P.; Agarwal, B. K.; Watal, C. (Allahabad Univ., India). Nuovo Cim., 55A: 338-41(May 21, 1968).

The space-spin structures of the matrix element for the inelastic process $\langle\pi^+N^{*-}|J^A_\lambda|p\rangle$ is investigated, and the consistency condition of the covariant amplitudes associated with this matrix element is derived. (L.B.S.)

32161 NOTE ON SUPERCONVERGENT SUM RULES FOR $KN \rightarrow KN$ AND $K\Xi \rightarrow K\Xi$ PROCESSES. Seth, V. P.; Sharma, M. C.; Agarwal, B. K. (Allahabad Univ., India). Nuovo Cim., 55A: 203-5(May 1, 1968).

A superconvergent linear combination of those amplitudes in the processes $KN \rightarrow KN$ and $K\Xi \rightarrow K\Xi$ which would have been left out of the calculation if taken separately is studied. These two processes have the same Regge trajectory in the t-channel. The nontrivial superconvergent sum rules are tested by taking contributions from all possible known single-particle states. The amplitudes in the s-channel were obtained by using appropriate isotopic spin projection operators. When the intermediate mass is below the threshold the Born approximation is used, and above threshold the Breit-Wigner formula. In this way the sum rules are found and given. (J.F.P.)

32162 WEAK AXIAL-VECTOR COUPLING CONSTANT IN THE STATIC CHEW-LOW MODEL. Pradhan, T.; Pattnaik, M. (Saha Inst. of Nuclear Physics, Calcutta). Nuovo Cim., 55A: 59-65(May 1, 1968).

By properly defining weak currents so as to include the mesonic contributions and thereby have them satisfy the chiral $SU_2 \times SU_2$ algebra, it is shown that the axial-vector coupling constant is renormalized by a factor $|G_A/G_V| = 1.13$ due to static pion-nucleon interaction, $H = (f_0/\mu)\tau_\alpha\sigma\cdot\nabla\varphi_\alpha$. It is also shown that $1 \le (G_A/G_V)^2 \le 3/2$ in this model. (auth)

32163 P AND P' REGGE POLE PARAMETERS FROM INVERSE DISPERSION RELATIONS. Miyamura, Osamu; Takagi, Fujio (Tohoku Univ., Sendai). Progr. Theor. Phys. (Kyoto), 39: 858-60(Mar. 1968).

The P and P' Regge pole parameters for forward pion-nucleon scattering at high energy are determined using two inverse dispersion relations of superconvergent type. (L.B.S.)

32164 BACKWARD PION-NUCLEON SCATTERING AND FERMION-EXCHANGE MECHANISMS. Contogouris, A. P. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France); Tran Thanh Van, J.; Le Bellac, M. Nucl. Phys., B5: 683-92(1968).

It is shown that interference of the N_α and N_γ fermion trajectories offers an alternative explanation of the dip observed in the high-energy backward π^+p differential cross sections at $u \approx -0.15\ (GeV/c)^2$. It is also shown that this mechanism predicts a nucleon polarization P which, in general, oscillates as a function of u and attains rather large values ($|P| \gtrapprox 0.35$); this is in contrast with the mechanism of dominance by N_α exchange, which at high energy necessarily leads to a small P($\lessapprox$0.1), smoothly varying with u. (auth)

32165 REMARK ON THE REGGE-POLE MODEL FOR THE PROCESSES $\pi(K)p \rightarrow \pi(K)N^*$. Hayashi, M. (Jagellonian Univ., Krakow). Acta Phys. Pol., 33: 341-2(Feb. 1968).

Corrections to the Bialas-Kotański relation, arising from low-lying trajectories, are investigated. (auth)

32166 PION-NUCLEON COUPLING CONSTANT FROM SPIN-FLIP DISPERSION RELATION. Harun-ar Rashid, A. M.; Islam, Md. Mozaharul (Atomic Energy Centre, Dacca, Pakistan). Acta Phys. Pol., 33: 203-7(Feb. 1968).

Single variable dispersion relation for the spin-flip part of the pion-nucleon scattering amplitude is used to obtain a value of the pion-nucleon coupling constant. The method has the advantage of using accurately known phase-shifts from the recent analyses. (auth)

32167 COMPLEX SINGULAR POTENTIAL INTERPRETATION OF LOW ENERGY KN AND $\bar{K}$N SYSTEMS. Spector, Richard M.; Chand, Ramesh (Wayne State Univ., Detroit). Progr. Theor. Phys. (Kyoto), 39: 682-9(Mar. 1968).

The low energy data on the $\bar{K}$N and KN systems are investigated in a complex singular potential model. Using $V(r) = G^2\,[\exp(-i\Delta)]/r^n (n > 3)$, it is found that the experimental data for these systems require n = 4, which is in agreement with the results of Kouris for p-p and π-p high energy scattering. (auth)

32168 $(\pi-\Sigma)_{I=0,1}$ AND $\bar{K}$-N SCATTERING LENGTHS: EXPERIMENTAL AND THEORETICAL VALUES. von Hippel, Frank (Stanford Univ., Calif.); Kim, Jae Kwan. Phys. Rev. Lett., 20: 1303-6(June 3, 1968).

Experimental values of the $(\pi-\Sigma)_{I=0,1}$ and $\bar{K}$-N scattering lengths derived from a coupled-channel effective-range analysis of the reactions $\bar{K} + N \rightarrow (\bar{K} + N, \pi + \Sigma, \pi + \Lambda)$, and theoretical values obtained by use of the soft-meson estimates of the scattering lengths in a role similar to that of known subtraction constants are presented. Agreement of theory with experiment is within experimental error except for the I = 0 $\overline{K}$-N scattering length where the disagreement is by 40%. (auth)

32169 VACUUM FLUCTUATIONS AND SELF-ENERGIES IN MESON THEORY. Hope, Lawrence L. Hoboken, N. J., Stevens Inst. of Tech., 1967. 108p.
Thesis.

The methods and viewpoint developed by Sokolov, Kramers, and Schiller for quantum electrodynamics are applied in meson theory. The spin and isospin of a model nucleon are assumed to interact with an external magnetic field as well as with self and external meson fields. Vector and scalar meson theories, including variational principles, are developed separately. The particle equations of motion incorporate the radiation reaction. The magnetic moments of the model nucleon are evaluated by differentiating the particle self energy with respect to the external magnetic field. These magnetic moments are finite. No perturbation expansion in the meson-nucleon coupling constant is used. (Disser. Abstr.)

32170 SOME SIMPLE BOOTSTRAP MODELS. Udgaonkar, B. M. (Tata Inst. of Fundamental Research, Bombay). pp 117-30 of Symposia on Theoretical Physics and Mathematics. 7. Ramakrishnan, Alladi (ed.). New York, Plenum Press, 1968.

A class of simple bootstrap models, based on the ideas that approximations based on nearby singularities and a suitable parametrization of short-range effects such as cutoffs, Balazs poles etc. are reasonably adequate for many purposes, is discussed. Mass predictions are not considered, but multiplet structure, particle spectra, and relative couplings are discussed. These models are in a sense a natural generalization of the Chew reciprocal bootstrap for N and N*. The other topics covered include the strong coupling series, extension to higher symmetries, and bootstrap with only a finite number of baryon multiplets. (J.F.P.)

32171 VECTOR EXCHANGE AND S-WAVE PION-NUCLEON SCATTERING. Brehm, J. J. (Northwestern Univ., Evanston, Ill.). Nuovo Cim., 55A: 143-58(May 1, 1968).

Several very interesting effects have begun to manifest themselves in the difficult data analysis of πN S-waves. All of these involve the influence of inelastic channels coupled to πN. Since the ρ-exchange force has been very successful in the understanding of the low-energy phenomena, it seems worth-while to pursue the implications of this force to higher energies in a many-channel formalism. Wyld has done this in a Schrödinger model; here it is undertaken in a dispersion theory framework. All of the relevant pseudoscalar meson-baryon channels are included and the vector-meson exchange force is prescribed to be SU_3 symmetric. For degenerate masses a bound unitary singlet and two degenerate bound octets occur. For physical mass splittings only one S_{11} resonance survives. A curious extinction phenomenon suppresses the πN component in the wave function of the resonance so that it does not show up strongly in πN elastic scattering. The S_{11} resonance is found at 1690 MeV and is interpreted as a bound state of the KΣ system. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 32154, 32675, and 32676.

32172 MONTE CARLO CALCULATION OF THE NUCLEON-MESON CASCADE INDUCED IN IRON BY 1- AND 3-GeV PROTONS. Armstrong, T. W. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 405-6(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32173 POSSIBLE EXISTENCE OF KINKS IN HIGH-ENERGY ELASTIC pp SCATTERING CROSS SECTION. Chou, T. T.; Yang, C. N. (State Univ. of New York, Stony Brook). Phys. Rev. Lett., 20: 1213-14(May 20, 1968).

Using a model proposed earlier and experimental proton form factors, the high-energy elastic pp scattering cross section is computed. (auth)

32174 EFFECTS OF THE S-STATE PION-NUCLEON INTERACTION ON THE PARTIAL-WAVE NUCLEON-NUCLEON ABSORPTIONS. Francaviglia, S. (Istituto Superiore di Sanita, Rome). Progr. Theor. Phys. (Kyoto), 39: 676-81(Mar. 1968).

The absorption in proton-proton scattering around 1 GeV of laboratory kinetic energy of incident proton are computed. A previous calculation is extended by taking into account, besides the production of the resonance $I = 3/2$, $J = 3/2$ (P_{33}), the production of pions in S_{11} and S_{31} state in respect to one nucleon as inelastic process. These waves are the most important in the hypothesis of P_{33} dominance in the scattering. The $^3P_0$ and $^3P_1$ absorptions are found to violate the unitarity limits while the other waves are almost unaffected. (auth)

32175 POSSIBLE NARROW DIPS IN THE HIGH-ENERGY PROTON-PROTON SCATTERING AT LARGE |t|. Sawada, T. (Univ. of Colorado, Boulder). Nuovo Cim., 55A: 342-5(May 21, 1968).

Equations are obtained for Regge parameters $\overline{\alpha}(\eta)$ and $\beta(\eta)$ where $\eta = \sqrt{-t} > 0$, and their general solutions are used in the equation for the elastic differential cross section determined up to two arbitrary periodic functions. The position and shape of dips appearing in certain terms of the elastic scattering amplitude are examined for finite momentum transfer and small scattering angle. The results are extended to the case of large scattering angle or relatively large |t|. (L.B.S.)

32176 THE REACTION ON $p + p \rightarrow d + \pi^+$. Brown, D. J.; Sundaresan, M. K. (Carleton Univ., Ottawa). Nuovo Cim., 55A: 346-8(May 21, 1968).

An attempt is made to calculate the differential cross section for the $p + p \rightarrow d + \pi^+$ interaction at 2.8 GeV based on the model of a single-nucleon exchange. Reasonable fits to the experimental data were obtained. (L.B.S.)

32177 ANALYSIS OF THE PERIPHERAL MODEL FOR THE PROCESS $p + p \rightarrow p + n + \pi^+$ AT 0.5 TO 0.7 GeV. Suslenko, V. C. (Radium Inst., Leningrad); Kochkin, V. L. Nucl. Phys., B5: 657-72 (1968).

Theoretical calculations on the basis of the peripheral model (taking care of energy and momentum conservation by using a convenient reference system [the L_R-system]) have been compared with π^+ meson experimental data for the process $p + p \rightarrow p + n + \pi^+$ at incident energies T = 556 and 660 MeV and different lab angles. Good qualitative agreement suggests that the peripheral model concepts may be applicable in the given energy region. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstracts 32688 and 32719.

32178 CP VIOLATION. Okun, L. B. (Inst. for Theoretical and Experimental Physics, Moscow); Rubbia, C. pp 301-45 of Proceedings of the Heidelberg International Conference on Elementary Particles. Filthuth, H. (ed.). New York, John Wiley and Sons, Inc., 1968.

See CONF-670934.

Some problems of CP violation in weak decays (mainly in K decays), in strong and electromagnetic processes with particular attention to the a-particle model, and in the gravitation interaction considering the nonexistence of the gravitational dipole moment. Also briefly considered are the possible properties of the mirror particles which are invented to preserve the mirror symmetry in nature in spite of the CP violation. CPT invariance is assumed. (J.F.P.)

32179 DIRAC SPINORS, COVARIANT CURRENTS AND THE LORENTZ GROUP OVER A FINITE FIELD. Beltrametti, E. G.; Blasi, A. A. (Univ., Genoa. Istituto Nazionale di Fisica Nucleare, Genoa). Nuovo Cim., 55A: 301-17(May 21, 1968).

After a brief review of the proper rotation and Lorentz groups over a finite geometry, Dirac spinors and covariant currents are analyzed in this framework. First, it is shown that the representations become unitary with respect to the rotation group only if thought of as ray representations. The proper Lorentz group is then extended through the space inversion: as a typical feature of the finite version of the Lorentz group, it is shown that there exist two kinds of Dirac spinors, say $\psi^{(e)}$, e = 0, 1, which transform under inequivalent ray representations. Looking at the bispinor sesquilinear forms (or currents) it is then found that the covariance properties are different according to whether the current is built with spinors of the kind e = 0 or e = 1; in particular, for the choice e = 1 only vector or axial-vector currents may be formed. (auth)

32180 PRIMENENIYE TEORII GRUP V KVANTOVOY MEKHANIKE. (Application of Group Theory in Quantum Mechanics). Petrashen', Mariya Ivanovna; Trifonov, Evgenii Dmitrievich. Izdatel'stvo Nauka, 1967. 307p.

The fundamentals of the theory of finite and continuous groups and the application of the group-representation theory to problems of quantum mechanics are discussed. The applications discussed refer to such areas of quantum mechanics as atomic theory, quantum chemistry, solid state theory, and relativistic quantum mechanics. A number of questions are included which are either not discussed previously or not discussed in adequate detail. This applies primarily to the study of the symmetry of the Schroedinger wave function, to an explanation of the "additional" degeneration in a Coulomb field, and to some questions of solid state theory. (ATD)

32181 SPONTANEOUSLY BROKEN SYMMETRIES: THE GENERALIZED FREE FIELD AND THE ZACHARIASEN–THIRRING–LICHT FIELD. Reeh, H. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Nuovo Cim., 55A: 13-26(May 1, 1968).

The generalized free field and the Zachariasen model in the formulation of Thirring and Licht are investigated from the point of view of whether they permit automorphisms of the associated algebras which are inplementable by unitary operators for local regions but not globally, and which therefore are candidates for broken symmetries. The result is rather negative. The only possibility is to add a constant to a free zero-mass field if such a field is contained in the model. The S-matrix is invariant. (auth)

32182 NORMALIZATION OF SOLID HARMONICS FOR U(3). Kayama, Tokuichi (Kyoto Univ.). Progr. Theor. Phys. (Kyoto), 39: 850-1(Mar. 1968).

The normalization of the solid harmonics for U(3) is discussed. The solid harmonics are based on a previously proposed theory of generalized spherical functions which are closely connected with representations of the unitary group. (L.B.S.)

32183 CLEBSCH–GORDAN COEFFICIENTS FOR SU(3). Kayama, Tokuichi (Kyoto Univ.). Progr. Theor. Phys. (Kyoto), 39: 851-3(Mar. 1968).

A method is proposed for calculating the Clebsch–Gordan coefficients for SU(3) by making use of the normalized solid harmonics. (L.B.S.)

32184 CAUSALITY AND CONFORMAL INVARIANCE. Castell, L. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Nucl. Phys., B5: 601-5(1968).

Causality is defined for certain homogeneous spaces of physically admissible real simple Lie groups. The example of the symmetric pseudo-Riemannian space $SO_0(4.2)/SO_0(4.1)$ is discussed in detail. (auth)

32185 GENERAL RELATIONS FOR C AND G PARITIES OF PARTICLE–ANTIPARTICLE SYSTEMS WITH ARBITRARY SPIN AND ISOSPIN. Laverriere, R.; Proriol, J.; Thevenet, C. (Institut de Physique Nucleaire, Lyon). Amer. J. Phys., 36: 258-61(Mar. 1968).

The eigenvalues of the charge conjugation C and of the G transformation for particle–antiparticle systems of arbitrary spin and isospin are derived. The eigenvalues are given by the formulas $C = (-)^{L+S}$ and $G = (-)^{L+S+T}$ where L is the angular momentum, S the spin, and T the isospin of the particle–antiparticle system. (auth)

32186 WIGNER COEFFICIENTS OF THE THREE-DIMENSIONAL LORENTZ GROUP. Ferretti, I.; Verde, M. (Univ., Turin). Nuovo Cim., 55A: 110-24(May 1, 1968).

The Lorentz group in three dimensions L_3 is the Wigner little group corresponding to spacelike momenta. An explicit calculation of the 3-j coefficients of L_3 is made. Their behavior under interchanging or changing of signs of the five independent parameters which identify them was also investigated. The method used is of some interest since it is in principle susceptible of extending to L_3 all the Racah algebra familiar from the three-dimensional rotation group. (auth)

Applications (Electromagnetic and Weak)

32187 ASYMPTOTIC BEHAVIOR OF VERTEX FUNCTION IN THE THEORY OF NONRENORMALIZABLE CP-ODD INTERACTION OF PHOTONS WITH SPINOR PARTICLES. Arbuzov, B. A.; Atakishiev, N. M.; Filippov, A. T. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 7: 690-5(Mar. 1968). (In Russian).

The ladder approximation for the vertex function is considered for the nonrenormalizable, theory violating CP invariance. In the Euclidian momentum region the asymptotics of the exact solution are found as well as the exact solution for zero fermion mass. The vertex function in the pseudoeuclidian region is obtained by means of the analytical continuation of this exact solution. The obtained function has conventional analytical properties, it decreases with the momentum in space-like directions and increases with the momentum in time-like directions. As the imaginary part of the vertex exponentially increases along the cut, the dispersion relation with a finite number of subtractions cannot be written. (auth)

32188 C VIOLATION IN THE MINIMAL ELECTROMAGNETIC INTERACTION OF VECTOR MESONS. Chkareuli, J. L. (Inst. of Physics, Tbilisi, USSR). Yadern. Fiz., 7: 612-15(Mar. 1968). (In Russian).

A model of CP violation based on the weak radiative transitions in the vector meson nonet is considered. Its various experimental consequences are summarized. (auth)

32189 THE SU(3) SYMMETRY AND VIOLATION OF THE $\Delta T = 1/2$ RULE IN $K \rightarrow 2\pi$ DECAYS. Zakharov, V. I. Yadern. Fiz., 7: 607-11(Mar. 1968). (In Russian).

The $\Delta T = 1/2$ rule is assumed to be violated by electromagnetic interactions only. It is shown that in this case the $\Delta T = 5/2$ transitions in the $K \rightarrow 2\pi$ decays are forbidden in the unitary symmetry limit. Arguments are given implying that if the $\pi\pi$-scattering s-wave phase shift is large at the total energy equal to the K-meson mass, then the SU(3)-symmetry predictions for the $K \rightarrow 2\pi$ decays are in general strongly violated. (auth)

32190 ELECTROMAGNETIC T-VIOLATING EFFECTS IN WEAK PROCESSES. Bailin, David (Univ. of Sussex, Eng.). Ann. Phys. (N. Y.), 47: 79-102(1968).

Under the assumption that a W-boson mediates the weak interactions, and that it possesses an intrinsic electric dipole moment, the radiative corrections to its electromagnetic moments are calculated. In addition the consequent T-violating effects which can be observed in the leptonic decays of the $W^{\pm}$, $\mu^{\pm}$, n and K_L^0 are computed. The relevance of the hypothesis to the decay $K_L^0 \rightarrow \pi^+\pi^-$ is discussed, and finally the effects of the assumption on the electromagnetic form factor of the neutrino is investigated. (auth)

32191 CP-VIOLATION IN η, K^0 DECAYS, AND THE $\Delta I = 2$ SELECTION RULE. Inaoka, Kozo; Koyama, Hideyuki (Osaka Univ. Univ. of Osaka Prefecture). Progr. Theor. Phys. (Kyoto), 39: 751-67(Mar. 1968).

CP-violation in various decay processes of η and K^0 is investigated phenomenologically under the assumption that C-violating and P-conserving interaction H_F satisfies the $\Delta I = 2$ selection rule and is of order α. The results are found to be consistent with the Dalitz plot of the decay $\eta \rightarrow \pi^0\pi^+\pi^-$ observed by Franzini et al. and the ratio $\Gamma(\eta \rightarrow \pi^0\pi^0\pi^0)/\Gamma(\eta \rightarrow \pi^0\pi^+\pi^-)$, without $\Delta I = 3$ C-conserving interaction. The decay $\eta \rightarrow 3\pi$ is further assumed to be dominated by the C-violating $\eta\pi\rho$ coupling with $\Delta I = 2$, which leads to C-violation in the other η decays: $\eta \rightarrow \pi^0 e^+ e^-$ and $\eta \rightarrow \pi\pi\gamma$. The magnitude of CP-violation in weak K^0 decays: $K_L \rightarrow \pi l \nu$, $K_L \rightarrow \pi\pi$ $(I = 2)$ and $K_L \rightarrow \pi^0\pi^+\pi^-$ are roughly estimated by a method of a Cabibbo transformation of the C-violating effective $\eta\pi^0$ current which belongs to a $10-10^*$ representation of the SU(3) group. With the aid of the experimental values of Franzini et al., these calculated results on η and K^0 are shown to be consistent with a recent experiment. (auth)

Applications (Strong)

Refer also to abstract 32139.

32192 SU(6)-REPRESENTATION MIXING IN COVARIANT CHIRAL U(6) × U(6) SCHEME OF BARYON–MESON INTERACTIONS. Itabashi, Kiyomi (Tohoku Univ., Sendai). Progr. Theor. Phys. (Kyoto), 39: 717-41(Mar. 1968).

Covariant chiral $U(6) \otimes U(6)$ scheme proposed in a previous paper is improved in two points. First, the ordinary $(1/2)^+$ baryon octet is taken to be a suitable mixture of SU(6) 56 and 70 (even when it is at rest). The mixing rate is chosen so as to make the g_A/g_V ratio of neutron β-decay agree with the experimental value. Secondly, in place of the previous form of baryon currents, alternative covariant form is proposed. The new vector and axial-vector baryon currents $j_\mu^{V,A}$ are closely connected with those of the algebra of currents in the following sense: For transitions between baryons both at rest, the effects of (j^A, j_0^V) and of $(j_0^V, j_0^A/y)$ are equivalent to those of the U(6) and the chiral $U(3) \otimes U(3)$ generators, respectively. Here, y is an adjustable parameter giving a measure of relative strength of transitions between different parity baryons versus those between the same parity baryons. As for the 0^- and $1^{\pm}$ mesons, there is no room for SU(6) mixing in the present scheme. Baryons interact with pseudoscalar mesons through the four-dimensional divergence of the new j_μ^A multiplied by a constant factor g, which is adjusted so as to give a correct value for the $NN\pi$ coupling constant. With this revised scheme, the widths and decay branching ratios of baryon resonances are calculated and are compared with experiment. Particularly for the $(3/2^+; 10)$ and $(3/2^-; 8)$ baryons, the results are surprisingly good. (auth)

32193 N/D CALCULATION FOR THE MASS SPLITTING OF BARYONS IN BROKEN $U_{6,6}$ SYMMETRY. Huq, M. (Syracuse

Univ., N. Y.); Miah, M. A. W. Contract AT(30-1)-3399. Nuovo Cim., 55A: 159-69(May 1, 1968). (NYO-3399-128).

The meson-baryon scattering is considered in the context of $U_{6,6}$ symmetry and study the mass splitting of the baryon octet and decouplet by the N/D method. It is assumed that the SU_3 symmetry is exact so that the masses of the baryon octet and decouplet obtained by using the $U_{6,6}$ vertices in the calculation should correspond roughly to their respective SU_3 degenerate masses. Although the results are very much cut-off dependent, the calculation shows that by varying the cut-off, S_c and $U_{6,6}$ coupling, g^2 parameters it is possible to obtain the mass splittings in the right direction. Considering the very much involved nature of the calculation, one may conclude that the results agree reasonably well with the known experimental facts. (auth)

32194 BOSON 27-PLET IN THE UNITARY-SYMMETRY MODEL. Gastmann, R.; Halzen, F. (Univ., Louvain, Belg.). Nuovo Cim., 55A: 1-12(May 1, 1968).

Mass spectra and decay rates of a 27-plet of bosons in the unitary-symmetry model are described. It is shown that SU_3, Martin's "effective threshold" method and the 405 of static SU_6 give results in remarkable agreement with one another. Consequences of possible mixing with one of the many experimentally established meson nonets are examined. Special attention is given to the $I = 2$ $\rho\pi$ resonance, recently proposed. (auth)

32195 TRIALITY AND FREEDOM OF HADRONS. Azuma, Shuko (Fukusima Univ., Japan). Progr. Theor. Phys. (Kyoto), 39: 847-8(Mar. 1968).

A model of hadrons is presented, which gives rise to irreducible representations of SU(3) of zero triality only. It is assumed that elementary particles have an internal space, and that each hadron is associated with a pattern in this space. The multiplicities of these patterns are interpreted as internal freedoms of elementary particles. (L.B.S.)

Field Theories

General

32196 INTRODUCTION TO SPECIAL RELATIVITY. Schwartz, Herman M. International Series in Pure and Applied Physics. New York, McGraw-Hill Book Company, 1968. 468p. $14.75.

The principle ideas and methods of the special theory of relativity are presented, and an indication of the place of this theory in current fundamental research is given. The basic ideas of Newtonian mechanics and Galilei–Newtonian relativity, a historical review, the special theory of relativity and its basic kinematic results, relativistic mechanics, tensor analysis in flat spaces, relativistic mechanics of continuous media, the electromagnetic field, and relativity and quantum mechanics are covered. (J.F.P.)

Quantum Field Theory

Refer also to abstracts 32078 and 32127.

32197 (ITF-67-38) USLOVIE PRICHINNOSTI I SOOTNOSHENIE MEZHDU AKIOMATIKAMI BOGOLYUBOVA I LEMANA-SHIMANCHIKA-TSIMMERMANA. (The Casualty Condition and Relation Between Bogoliubov's and Lehmann-Symanzik-Zimmerman's Axiomatic). Medvedev, B. V.; Polivanov, M. K.; Sukhanov, A. D. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1967. 17p. (In Russian). Dep.

Current-like operators Λ_n to clarify the difference between the Bogoliubov and L.-S.-Z. axiomatics and some other problems are discussed. The causality condition is obtained in L.-S.-Z. axiomatics, which is more restrictive than Bogoliubov's microcausality condition written in the adequate form. The results are discussed from the Lagrangian point of view and from the point of view of renormalizability problem in quantum field theory. (auth)

32198 (LNF-68/17) A REVIEW OF HIGH ENERGY WORK IN QUANTUM ELECTRODYNAMICS. Internal Note No. 394. Silvestrini, V. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). Mar. 28, 1968. 28p. Dep.

A review is given contributing to the understanding of the direction and extent to which a breakdown of QED can be expected consistent with the available experimental and theoretical information. The validity of QED, modified QED theories, propagator modifications, vertex modifications, the magnetic moment, high energy, dynamical tests, and tests of a model for QED breakdown in terms of a heavy electron are discussed. (J.F.P.)

32199 FORMULATION OF THE ADIABATIC HYPOTHESIS IN AXIOMATIC FIELD THEORY. Medvedev, B. V.; Polivanov, M. K. Dokl. Akad. Nauk SSSR, 177: 816-9(Dec. 1967). (In Russian).

A formulation of quantum field theory is sought in which only the physical asymptotic fields and the S-matrix determined axiomatically are introduced from the very beginning. Even in this case it is necessary to deal with generalized functions and their derivates. This problem is closely related to the purely mathematical problem of the correct predetermination of certain integrals and of establishing the order of action in expressions containing zeros, poles and δ-functions as multipliers. The adiabatic hypothesis of perturbation theory serves as a means of predetermination. In axiomatic formalism a number of rules which will be equivalent to the adiabatic hypothesis should still be formulated. An integral containing arbitrary δ-functions is taken as a typical example of an expression requiring predetermination. The resulting formula that is derived and its analogs contain a formal means of dealing with integrals containing derivatives from δ-functions. The correct result can be obtained automatically in use with complex expressions requiring repeated application of the method. (TTT)

32200 QUANTUM ELECTRODYNAMICS WITH THE EXTERNAL CURRENT AND POTENTIAL. Shirokov, M. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 7: 672-84(Mar. 1968). (In Russian).

The operators of production-annihilation of particles, the vacuum vector of which is the physical vacuum for the models "electromagnetic field with the external current" and "electrons in the external potential" entering as components into the theory under discussion, are introduced. The formalism constructed allows one to solve problems with nonstationary currents and with potentials of the type of radiophoton emission by antenna or of electron scattering by the laser ray described by the nonquantized plane electromagnetic wave. (auth)

32201 RENORMALIZED AND NONRENORMALIZED GREEN'S FUNCTIONS IN THE AXIOMATIC FIELD THEORY. Polivanov, M. C. (Inst. of High Energy Physics, Moscow). Yadern. Fiz., 7: 654-63(Mar. 1968). (In Russian).

The T-product and the current-like operator are separated in the second-order radiation operator, using the analytic properties of the Green's function. The necessary extension of the S matrix is determined by supplementary conditions that fix the normalization of the Green's function. After fixing the degree of growth of the matrix element the arbitrariness is reduced to the possible choice of the renormalized or the nonrenormalized extension of the S matrix. (auth)

32202 FIELD THEORY WITH SEMI-DEFINITE METRICS. Naumov, A. I. (Moscow State Univ.). Yadern. Fiz., 7: 664-71 (Mar. 1968). (In Russian).

The field theory with indefinite (more strictly, with positive semi-definite) metrics is given. Within this theory, one succeeds in getting a probability interpretation, in constructing a unitary physical scattering matrix without the macrocausality violation and in formulating the perturbation theory without divergences. (auth)

32203 ON A CLASS OF SOLUTIONS OF THE DIRAC EQUATION. Shabad, A. E. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz., 7: 685-9(Mar. 1968). (In Russian).

Homogeneous solutions and the Green's function for the Dirac equation are expressed in terms of the known solutions of the one-dimensional Schroedinger equation in the case of four vector external potentials varying along one of the space-like directions and with the polarization four vector on the light cone. Properties of the potentials in view are discussed. (auth)

32204 LIMITING PROCESS OF CUTOFF AND AUXILIARY FIELDS IN QUANTUM FIELD THEORY. I. Yokoyama, Kan-ichi (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto), 39: 830-46 (Mar. 1968).

A tentative approach to a simplified model, by which the model is reformulated in order to derive no infinity before renormalization, is investigated. To achieve the view a limiting process of an invariant cutoff and a pair of auxiliary fields with indefinite metrics are introduced. These auxiliary fields are set up in such a way that they play the role of canceling out all divergences due to the original interaction of the model but not destroying the unitarity of the S-matrix within a Hilbert space with the positive metric. These circumstances are ensured by the limiting process of the cutoff. Self-masses of particles become finite. Nevertheless, their values are not determined on account of the presence of arbitrary parameters. It is to be thought that the different values of these parameters distinguish mass corrections to individual particles due to some unknown internal interactions for which one has no means of description. In a phenomenological viewpoint the presence of such parameters is rather convenient. Extension of the approach to other realistic theories seems to be possible. (auth)

32205 BEHAVIOR OF VERY-HIGH-ORDER PERTURBATION DIAGRAMS. Lam, C. S. (McGill Univ., Montreal). Nuovo Cim., 55A: 258-74(May 21, 1968).

A method of calculating the sum of all Feynman diagrams of order n for n → ∞ is presented and is illustrated for the cases of a harmonic oscillator perturbed by either a harmonic potential or an anharmonic potential, and also for a self-coupled neutral scalar field. For example, the sum of all n-th order diagrams with q external legs for a self-coupled neutral scalar field theory $\lambda\Phi^{2P}$ with a cut-off depends on n as $(n!)^{-1} \exp [pn \log n + an - (q/2) \log n] \times$ [polynomial in n of degree less than or equal to q], with a being a constant independent of q. (auth)

32206 GENERALIZATION OF THE LOPUSZANSKI THEOREM. Garczynski, W. (Wroclaw Univ.). Acta Phys. Pol., 33: 327-9(Feb. 1968).

A generalization of the Lopuszański theorem is given with the help of a method similar to that recently used by Csikor and Pócsik in their generalization of the Jost and Schroer result. It is shown that the action of an interacting field on any vector can not be represented as a result of action of a free field operator on this vector, or even, on any linear combination of some vectors, unless the interaction vanishes. (auth)

32207 CLASSICAL MOTION OF PARTICLES AND THE PHYSICAL-REGION SINGULARITY OF THE FEYNMAN INTEGRAL. Nakanishi, Noboru (Kyoto Univ.). Progr. Theor. Phys. (Kyoto), 39: 768-71(Mar. 1968).

It is shown that to take the classical limit of the Feynman integral exactly coincides with the condition of the Landau singularity in the physical region. (auth)

32208 A SEMI-PERTURBATIVE ANALYSIS OF CHARGE RENORMALIZATION. Yock, P. C. M. (Univ. of Auckland, N. Zealand). Nuovo Cim., 55A: 217-32(May 21, 1968).

The unrenormalized Schwinger–Dyson equation for the vertex function of quantum electrodynamics is discussed in the first approximation of the semi-perturbative scheme of Johnson, Baker, and Willey. It is found that the equation does not possess a unique bounded solution. The most general solution consistent with Ward's identity is obtained, and this yields an infinite value for the charge renormalization constant, Z_3^{-1}. (auth)

Gravitation and General Relativity

Refer also to abstracts 31556, 32083, and 32178.

32209 (KFKI-9/1968) A METHOD FOR CONSTRUCTING CERTAIN AXIALLY SYMMETRICAL EINSTEIN–MAXWELL FIELDS. Perjes, Z. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). Apr. 10, 1968. 5p. Dep.

It is shown that the existing cylindrical static electric and magnetic fields are in a certain linear connection, simplifying the field equations. Furthermore a method is given to translate results of the cylindrical static Einstein-Maxwell theory to the cylindrical stationary free gravitational case and inversely. As an example of the use of this method, the gravitational field of a magnetic dipole is obtained from the Kerr metric. (auth)

32210 GRAVITATIONAL-WAVE-DETECTOR EVENTS. Weber, J. (Univ. of Maryland, College Park). Phys. Rev. Lett., 20: 1307-8(June 3, 1968).

A new series of experiments is described, involving two gravitational wave detectors spaced about 2 km. A number of coincident events were observed, with extremely small probability that they are statistical. It is clear that on rare occasions these instruments respond to a common external excitation which may be gravitational radiation. (auth)

32211 FOURTH TEST OF GENERAL RELATIVITY: PRELIMINARY RESULTS. Shapiro, Irwin I.; Pettengill, Gordon H.; Ash, Michael E.; Stone, Melvin L.; Smith, William B.; Ingalls, Richard P.; Brockelman, Richard A. (Massachusetts Inst. of Tech., Lexington). Phys. Rev. Lett., 20: 1265-9(May 27, 1968).

An experiment designed to verify the prediction that the spread of propagation of a light ray decreases as it passes through a region of increasing gravitational potential is considered. A detailed discussion is given of the data analysis and the novel experimental techniques required by the echo signal being sometimes as small as 10^{-21} W, i.e., about 10^{27} times as weak as the transmitted signal power of about 300 kW. Post-fit residuals of earth–mercury and earth–venus time-delay data and a comparison of measured and predicted effects of general relativity on earth–mercury time delays are shown. It seems safe to conclude that the sun's gravity does slow the speed of propagation of light by about the amount predicted by Einstein's theory. (J.F.P.)

32212 NOVYYE METODY V OBSHCHEY TEORIIOTNOSITEL'-NOSTI. (New Methods in the General Theory of Relativity). Petrov, Aleksei Zinov'evich. Moscow, Izdatel'stvo Nauka, 1966. 495p.

The intensive development of field theory in modern physics, and particularly the theory of field gravitation within the framework of Einstein theory of relativity, demanded the application of modern mathematical methods. The application of invariant-group methods to the problems of the general theory of relativity. (ATD)

32213 RELATIVE MASS IN GENERAL RELATIVITY. Narlikar, V. V. (Univ. of Poona). Curr. Sci. (India), 37: 281-2 (May 20, 1968).

A formula for the relative mass of a particle in the de Sitter universe is obtained. It is shown how the relative mass of every particle bears witness to the contemporary (in the sense of the cosmic time) radius of the universe which may be contracting, expanding or oscillating. The cosmic behavior would be reflected in the relative mass of every inertial particle as in the Mach principle. (J.F.P.)

Scattering Theory

Refer also to abstracts 32077, 32201, and 32202.

32214 (JINR–P4-3741) PRIBLIZHENNOE ANALITICHESKOE RESHENIE URAVNENII V ZADACHAKH KVANTOVOI MEKHANIKI. (Approximate Analytical Solution for Equations in Problems of Quantum Mechanics). Amirkhanov, I. V.; Gur'yanov, V. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 13p. (In Russian). Dep.

An attempt was made of developing approximate analytical wave functions. A certain F(r) function $\int/F(r)/^2\, dr < \infty$ was reduced to a Fourier series $F(r) = \Sigma_n A_n \phi_n(r)$, (where $A_n = \int F(r)\phi_n(r) dr$). The Fourier series of any arbitrary quadratically integrable function converges in the mean linear integral equations. Such series are rapidly convergent when F(r) and its initial derivatives are continuous. The developed function was used to obtain the approximate analytical solutions for the scattering problem and for a system of integro-differential equations. (R.V.J.)

32215 PARAMETRIZATION OF THE S MATRIX IN NONORTHOGONAL BASIS. Bogoslovskii, G. Yu.; Klepikov, N. P. (Moscow State Univ.). Yadern. Fiz., 7: 644-53(Mar. 1968). (In Russian).

Unitarity and symmetry relations for the elements of the scattering matrix in the nonorthogonal basis and its parametrization method are presented. (auth)

32216 REGGEON GRAPHS FOR INELASTIC PROCESSES. Kancheli, O. V. (Inst. of Physics, Tbilisi, USSR). Yadern. Fiz., 7: 620-8(Mar. 1968). (In Russian).

Contributions from various Reggeon graphs to the amplitude of production of three particles with low transverse momenta are calculated. The conditions are discussed for the Reggeon-graph technique to be selfconsistent. The equation is considered that solves the problem of summing contributions to the amplitude from all the completely enhanced Reggeon graphs. (auth)

32217 KINEMATICAL SINGULARITIES IN CROSS SECTIONS AND DENSITY MATRICES. Cohen-Tannoudji, G.; Kotanski, A.; Salin, Ph. (CERN, Geneva). Phys. Lett., 27B: 42-4(May 27, 1968).

An analytic continuation procedure is proposed for cross sections and density matrix elements to discuss their possible kinematical singularities. As expected, the s channel cross section even when expressed in terms of the t channel amplitudes is free from kinematical singularities in the t variable whereas the density matrix elements in the Jackson frame can be singular at the t channel thresholds and pseudothresholds. (auth)

32218 BOOTSTRAP CONDITIONS IN S-MATRIX THEORY. Aramaki, Seiya (Nagoya Univ., Japan); Fukuzumi, Seiji; Ito, Masatosi. Progr. Theor. Phys. (Kyoto), 39: 166-81(Jan. 1968).

The bootstrap conditions are examined for some soluble models in the framework of S-matrix theory. The important role played by the high energy behavior and CDD zeros of the scattering amplitude for the validity of the bootstrap mechanism is pointed out. Special attention is paid to clarify the physical meaning of CDD zeros. Comparisons with field theoretical approaches are made in order to exhibit some aspects of the S-matrix theoretical approach. (auth)

32219 EFFECT OF HIDDEN CHANNELS ON LOW-LYING CHANNELS. Kinoshita, Kisei (Tokyo Univ.); Kinoshita, Yukiko; Murai, Nobuyuki. Progr. Theor. Phys. (Kyoto), 39: 108-17 (Jan. 1968).

The channel coupling effect is discussed for the two-channel amplitude when the threshold of the second channel is very high. The amplitude is written as the sum of the pure elastic term and the channel coupling term. In the low energy region in the first channel, the channel coupling term can be approximated by the modified Born term of an elementary particle ($Z_3 \neq 0$) or intermediate one ($Z_3 = 0$) corresponding to the cases whether the pure elastic term of the second channel contains a bound state or not, respectively. It is proposed to classify particles and resonances to three categories according to the dynamical origin of them. (auth)

32220 QUASI-POTENTIAL APPROACH AND THE EXPANSION IN RELATIVISTIC SPHERICAL FUNCTIONS. Kadyshevskii, V. G.; Mir-Kasimov, R. M.; Skachkov, N. B. (International Centre for Theoretical Physics, Trieste, Italy). Nuovo Cim., 55A: 233-57(May 21, 1968). (IC-67/72).

The expansion in matrix elements of unitary representations of the Lorentz group is applied in the relativistic quasi-potential scattering theory. A relativistic analog of the three-dimensional configuration space is found. The formalism developed is very close to the nonrelativistic one. It allows us to hope that in the framework of this approach, an adequate relativistic generalization of Regge's ideas can be found. (auth)

32221 RELATIVISTIC QUASI-POTENTIAL EQUATION IN THE CASE OF PARTICLES WITH SPIN. Kadyshevskii, V. G.; Mateev, M. D. (International Centre for Theoretical Physics, Trieste, Italy). Nuovo Cim., 55A: 275-300(May 21, 1968). (IC-67/68).

Quasi-potential equations are constructed for the relativistic scattering amplitude and the wave function of two interacting particles with spin $\frac{1}{2}$. This is done with the help of specific covariant extrapolation of the scattering amplitude off the energy-momentum shell. Suitable diagram techniques are developed. The quasi-potential is defined as a sum of "irreducible" diagrams. The free part of the wave equation is spin independent and all features connected with spin appear in the interaction (quasi-potential). The spin structure of the quasi-potential is investigated. (auth)

32222 CONSPIRACY RELATIONS FORMULATED IN TERMS OF DIRECT-CHANNEL AMPLITUDES. Le Bellac, M. (Laboratoire de Physique Theorique, Nice). Nuovo Cim., 55A: 318-22 (May 21, 1968).

A method was previously reported for writing the contribution of a Regge pole to direct s-channel helicity amplitudes; a general solution was written down under the condition that the Regge pole chooses evasion. The results are generalized to the case where a Lorentz pole characterized by a quantum number M is exchanged, namely a family of conspiring Regge poles. Attention is given only to the asymptotic behavior of the s-channel amplitudes. (L.B.S.)

32223 ON THRESHOLD CUSPS IN REGGE TRAJECTORIES. Jones, H. F. (Imperial Coll. of Science and Tech., London). Nuovo Cim., 55A: 354-6(May 21, 1968).

The possibility of threshold cusps in boson and fermion trajectories is investigated. It is shown that cusps are likely to appear in abnormal-parity fermion trajectories, and in particular in the N_β trajectory. It is further shown that in this case the nature of the cusp is such that a shift of the S_{11} resonance to a higher mass is to be expected. (L.B.S.)

32224 THE N/D APPROXIMATION IN POTENTIAL SCATTERING. Fung, Yun-tong (Chinese Univ. of Hongkong). Nuovo Cim., 55A: 363-6(May 21, 1968).

The N/D method of Chew and Mandelstam is applied to nonrelativistic scattering by a Yukawa potential at low incident energies. Results are presented for s, p, and d phase shifts along with the exact phase shifts, using the first Born approximation and also using the first and second Born approximations as inputs. (L.B.S.)

32225 PROOF OF A CONJECTURE ON THE BEHAVIOUR OF THE SCATTERING AMPLITUDE FOR LARGE IMAGINARY ANGULAR MOMENTA. Bertero, M. (Univ., Genoa); Kreuzer, H. J. Nucl. Phys., B5: 619-26(1968).

A conjecture concerning the connection between the behavior of the scattering amplitude for large imaginary angular momenta and the behavior of the potential is proved for a class of Yukawian potentials. Some consequences of this result on the structure of the double spectral function are discussed. (auth)

32226 HIGH-ENERGY BOUNDS FOR HELICITY AMPLITUDES OF ARBITRARY SPINS AND MASSES. Cornille, H.; Philippe, G. (Institut de Physique Nucleaire, Orsay, France). Nucl. Phys., B5: 627-40(1968).

The Kinoshita, Loeffel and Martin method for obtaining high-energy bounds for spinless particles is considered. For the extension in the ($\frac{1}{2}$,$\frac{1}{2}$) spin case it was previously realized that the helicity formalism is convenient, due to the great similarity properties between Legendre and Jacobi polynomials. The bounds for arbitrary masses and spins are generalized. First it is shown that in fact the spin can be considered as an "inessential complication" for these bounds. Using different dynamical models (uniform polynomial boundness, Mandelstam cuts . . .) the same energy and scattering angle dependence is found for the bounds in both cases whether the spin is present or not. Secondly, near forward (or backward) scattering, it is shown how purely kinematical effects, due to the features of helicity flip amplitudes (or not), modify the above spin-independent bounds. (auth)

32227 MANDELSTAM SYMMETRY IN THE S-MATRIX THEORY. Ida, Masakuni (Tokyo Univ.). Progr. Theor. Phys. (Kyoto), 39: 772-84(Mar. 1968).

The Mandelstam symmetry in single-channel nonrelativistic scattering is investigated without recourse to the Schroedinger equation. Results obtained in the Schroedinger theory are derived in an S-matrix theoretical way. It is shown that reflection symmetry points in the λ plane, where $\lambda = l + \frac{1}{2}$, are all fixed, and that they are given by all the finite end points of Regge trajectories at infinite energy as well as all the nonvanishing integers. (auth)

32228 IMPACT PARAMETER REPRESENTATION OF THE SCATTERING PROBLEM. PART II. Adachi, Toshimi; Kotani, Tsuneyuki (Tokyo Metropolitan Technical Coll. Tokyo Metropolitan Univ.). Progr. Theor. Phys. (Kyoto), 39: 785-816(Mar. 1968).

The new exact treatment of the scattering problem proposed by Adachi and Kotani is summarized in a more complete form. This impact parameter representation and the partial wave expansion are complementary. The former is more suitable in the short wavelength region, while the latter in the long wavelength region. By assuming a short wavelength approximation only, many formulas are simplified in the former expansion; in the case of the potential scattering, the simple relation between the scattering amplitude and the (optical) potential is obtained by applying this approximation to the correct solution in the complete form of the Born series. This result is identical with the form obtained under the eikonal or semiclassical approximation. It is proved that the total cross section in the high energy region is expressed accurately in this approximate form, but the angular distribution is less accurate for some cases. As examples, the scattering by a square well potential and the charge exchange scattering of protons by hydrogen atoms are discussed. The relations with the other impact parameter formalisms proposed by Blankenbecler and Goldberger and others are discussed. The solution obtained by Blankenbecler and Goldberger for potential scattering is shown to be the simplest solution which satisfies the unitarity relation under the short wavelength approximation. The reason why their solution is different from the eikonal form is explored by deriving the exact dispersion relation. The Schroedinger equation in the impact parameter representation is derived. (auth)

32229 NONSENSE CHANNELS AND "NON-REGGE" SINGULARITIES. Fujisaki, Haruo (Tokyo Univ.). Progr. Theor. Phys. (Kyoto), 39: 742-50(Mar. 1968).

The possible existence of "non-Regge" singularities in the helicity amplitudes is discussed. When the Mandelstam cuts are absent in the J-plane, the signatured partial-wave amplitudes have Gribov–Pomeranchuk essential singularities at "sense-nonsense" and "nonsense-nonsense" values of J with the wrong signature. When the Mandelstam cuts are present, it is shown that the Gribov–Pomeranchuk essential singularities are eliminated from both sheets of the J-plane, that there exist fixed branch points at "sense-nonsense" values of J with the wrong signature and fixed simple poles at "nonsense-nonsense" values of J with the wrong signature, and that these fixed singularities do not contribute to the asymptotic behavior of the total amplitudes. (auth)

32230 LOW-ENERGY EXPANSION OF THE S(k) MATRIX FOR THE SCHROEDINGER EQUATION WITH A CERTAIN TYPE OF SPHERICALLY SYMMETRIC POTENTIALS. Almstrom, H. (Royal Inst. of Tech., Stockholm). Nuovo Cim., 55A: 125-42 (May 1, 1968).

The potential V(r) treated is generally of such a long-range type that, when terms which for large r decrease at least exponentially are neglected, the limit potential equals $V_1(r) = \Sigma_{n=1}^{M}$

$c_n r^{-e_n}$ where $e_n > 0$ for all n. The $S_L(k)$ matrix corresponding to the L-th partial wave can in this case be reached in two steps. First the phase shifts produced by the above-defined limit potential $V_1(r)$ are determined. Subsequently the effect of the difference potential $V_e(r) = V(r) - V_1(r)$ can be determined. The $S_L(k)$ matrix is now obtained in a form, which is convergent when $|k| < p$. Here p is the largest value which makes the integral $\int_{a>0}^{\infty} |V_e(r)| \cdot \exp[2pr]dr$ convergent. The case $V(r) = cr^{-1} + dr^{-2} + V_e(r)$, which is of obvious importance, will be studied explicitly. In the case that $\lim_{r\to 0} r^2 V_e(r) \geq -d$ the physical solution takes for large r the form $u_L^{as}(k, r) \sim \sin(kr - L\pi/2 - \gamma \log 2kr + \delta_L(k) + \eta_L(k))$. Here $\delta_L(k)$ is the phase shift produced by the difference potential $V_e(r)$ while $\eta_L(k) = \arg \Gamma(L' + 1 + i\gamma) + (L - L')\pi/2$ is the phase shift produced by the limit potential $V_1(r)$. One obtains $\operatorname{ctg} \delta_L(k) = \{1 - \exp[2\gamma\pi]/\sin(2L'\pi)\} - \operatorname{tg}(L'\pi) + \{k^{-2L'-1}\Gamma(2L' + 2)\Gamma(2L' + 1)/(2^{L'}|\Gamma(L' + 1 + i\gamma)|)^2\} \exp[\gamma\pi] (\Sigma_{n=0}^{\infty} a_{L_n} k^{2n})/(\Sigma_{n=0}^{\infty} b_{L_n} k^{2n})$ where $\gamma = c/2k$ and $L' = (\frac{1}{4} + L(L + 1) + d)^{\frac{1}{2}} - \frac{1}{2}$ differ from an integer or half-integer. Here a_{L_n} and b_{L_n} are independent of k and essentially integrals over all space and whose integrands decrease at least exponentially for large values of the arguments. a_{L_n} and b_{L_n} are therefore suited for numerical calculations. (auth)

32231 SINGULARITIES OF MULTIPLE SCATTERING PROCESSES. Pham, F. (CEN, Saclay, France. CERN, Geneva). pp 17-63 of Symposia on Theoretical Physics and Mathematics. 7. Ramakrishnan, Alladi (ed.). New York, Plenum Press, 1968.

The discussion of singularities of multiple scattering processes includes a review of the simplest Landau singularities, multiple scattering thresholds, the singular structure of the S-matrix, and multiple scattering revealed in the space-time asymptotic behavior of the S-matrix. Also discussed are singularities of absorption integrals and a hierarchy of the singularities. (J.F.P.)

32232 FORMAL ASPECTS OF POTENTIAL THEORY. Scadron, M. (Imperial Coll. of Science and Technology, London). pp 101-16 of Symposia on Theoretical Physics and Mathematics. 7. Ramakrishnan, Alladi (ed.). New York, Plenum Press, 1968.

Some of the formal techniques that were previously applied to the nonrelativistic scattering of a particle in a fixed-source potential are summarized. Off-shell and half-shell techniques are considered. (J.F.P.)

Particle Accelerators

Refer also to abstracts 30868, 32383, and 32512.

32233 (AED-C-18-10) BIBLIOGRAPHIEN ZUR KERNFORSCHUNG UND KERNTECHNIK. SEKTION 18. BESCHLEUNIGER. (Bibliographies in Nuclear Science and Technology. Section 18. Accelerators). Mausberg, Wolfgang (comp.) (Zentralstelle fuer Atomkernenergie-Dokumentation, Frankfurt am Main (West Germany)). Mar. 1968. 113p. (In German and English). Dep.

A listing of 420 references on particle accelerators is presented. Subject and author indexes are included. (W.H.K.)

32234 (BNWL-684) LASER ELECTRON ACCELERATOR AS A NEUTRON SOURCE. Glasgow, D. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 1968. Contract AT(45-1)-1830. 37p. Dep. CFSTI.

An analysis was made of the feasibility of producing intense photoneutron sources by bombarding thick, heavy-metal targets with nuclear-pumped, laser-accelerated electrons. The maximum neutron yield per electron is obtained by bombarding thick lead or uranium targets with electrons of energy ≥100 MeV. There is a tendency for the photoneutrons to be focused in the forward direction at high electron energies. The neutron energy distribution is Maxwellian in shape with a pronounced high-energy tail. If the efficiency for converting energy from a 3000 MW reactor to accelerated electrons ≥1%, then source intensities $\geq 10^{17}$ n/sec are possible. A number of important physics experiments, now impossible or limited by neutron flux, are outlined which provide further justification for intense neutron sources. (auth)

32235 (CEAL-1043) A COMPARISON OF CEA AND SLAC FARADAY CUP CALIBRATION BY MEANS OF A SECONDARY EMISSION MONITOR. Dell, George F.; Fotino, Mircea (Cambridge Electron Accelerator, Mass.). May 23, 1968. Contract AT(30-1)-2076. 18p. (CONF-680430-2). Dep. CFSTI.

From Symposium on Beam Intensity Measurement, Daresbury, England.

A comparison of the beam monitoring devices used at CEA and SLAC is presented. Gold-plated aluminum foils were used as secondary emission monitors, and the Faraday cups used at both laboratories are described. (W.H.K.)

32236 (CEAL-2000) PROCEEDINGS OF THE SIXTH INTERNATIONAL CONFERENCE ON HIGH ENERGY ACCELERATORS, CAMBRIDGE, MASSACHUSETTS, SEPTEMBER 11-15, 1967. Mack, Robert A. (Cambridge Electron Accelerator, Mass.). Dec. 1967. 719p. (CONF-670930). CFSTI.

Separate abstracts were prepared for 122 of the 143 papers included in the conference proceedings. Twenty-one papers have been previously abstracted in NSA. For abstract numbers of these papers see CONF 670930 in a cumulative report number index. (B.G.D.)

For abstracts of individual papers see: 32237-32358.

32237 (CEAL-2000, pp 1-3) SUPPORT OF HIGH-ENERGY PHYSICS. Ramsey, Norman F. (Universities Research Association, Washington, D. C.).

The major problems involved for accelerator designers with respect to financial support are discussed. These are nonscientific restrictions on design parameters, long time scale, difficult to change plans, cooperation over wide geographical areas, site problems, coupling to other rational issues, need for economy in design and construction, importance of not exceeding budget, and provision for future flexibility. (B.G.D.)

32238 (CEAL-2000, pp 4-8) A 1000-GeV CYBERNETIC PROTON ACCELERATOR STUDIES. Mints, A. L.; Vasiliev, A. A.; Burshtein, E. L. (Akademiya Nauk SSSR, Moscow. Radiotekhnicheskii Institut).

The main characteristics of the 1000 GeV Cibernetic Proton Accelerator with the intensity $3.10^{13} - 10^{14}$ particles/pulse designed by the Radiotechnical Institute of the Academy of Sciences of the USSR are described. The accelerator assemblage consists of the three stages: the 800 MeV linear accelerator, the intermediate circular accelerator (booster) for an energy of 18 GeV and the main circular accelerator (main ring) for an energy of 1000 GeV. For the purpose of reducing the effect of various perturbations an application of automatic control systems is provided including the autocorrection of the beam position. The principal characteristics and the features of the main ring are described: the magnet, the rf accelerating system, the correction system and so on. (auth)

32239 (CEAL-2000, pp 9-13) JAPANESE 40-GeV PROTON SYNCHROTRON PROJECT. (Tokyo Univ. (Japan). Inst. for Nuclear Study).

Design parameters of the proposed 40-GeV proton synchrotron will be presented. As the main machine parameters, a maximum kinetic energy of 42 GeV and a mean intensity of 0.1 μA for the first phase have been fixed. The synchrotron consists of eight super periods, each of which comprises a 10-m free space (Collins straight section) and four identical pairs of cells. The mean radius of the ring is 200 m. A 125-MeV linac has been chosen as the injector after investigating various injector schemes. Principal design objective is to make the machine as simple as possible to assure stable and reliable operation of the machine. (auth)

32240 (CEAL-2000, pp 14-17) A PROTON SYNCHROTRON OF 23 TO 45 GeV. Levy-Mandel, R. ([Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires]).

A 45-GeV proton synchrotron has been proposed as a national facility. An alternative proposal has been made to the first one: a two steps solution is considered consisting essentially in installing the ring and the magnet in its final design in the neighborhood of Saturne, the Saclay 3 GeV accelerator. Using several parts of the present equipment allows operation at 23 GeV with 3×10^{11} p/sec in a first stage. General description of the project is given: main parameters, general layout and financial aspects. (auth)

32241 (CEAL-2000, pp 34-9) THE CANADIAN INTENSE NEUTRON GENERATOR. Tunnicliffe, P. R.; Bartholomew, G. A. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.).

Our proposed Intense Neutron-Generator would produce intense fluxes of thermal neutrons for solid state, low-energy nuclear physics, materials science research, and isotope production and of mesons and energetic nucleons for intermediate-energy nuclear physics. The neutron source, 10^{19} n/sec, would be generated by continuously bombarding a column of liquid Pb-Bi with 65 mA of 1-GeV protons. The thermal neutrons, 10^{16} n/cm^2 sec, would be generated in surrounding heavy-water moderator. Mesons would be produced by a transmission target in the proton beam. The protons would be accelerated by a linear accelerator based on the Los Alamos Meson Physics Facility design reoptimized for continuous operation. A future extension is planned to accelerate simultaneously ~0.5 mA of H^- ions. These can be split from the main beam magnetically and directed to a separate target. To accommodate this feature a 3:1 frequency transition is necessary, the Alvarez section operating at $268\frac{1}{3}$ MHz. Efficient generation of 90 MW of radio frequency power is expected using crossed-field power-amplifiers. The estimated cost of the basic facility, to be completed in 1974, is ~$150M (Can.). The proposal is now being considered by government; detailed theoretical and experimental studies are continuing. (auth)

32242 (CEAL-2000, pp 40-5) A BEAM BYPASS FOR THE 300-GeV PROTON SYNCHROTRON. Montague, B. W. (European Organization for Nuclear Research, Geneva (Switzerland)).

Current designs of future high-energy synchrotrons provide for a high ultimate degree of experimental utilisation. A beam bypass could enhance the flexibility of the 300 GeV machine by decoupling some of the conflicting requirements of the accelerator and the associated experiments. As well as easing problems of induced activity, facilitating installation of equipment near a machine orbit etc., the bypass could provide a useful range of experimental facilities, including colliding-beam regions. The use of superconducting bending magnets, concentrated at the ends of the bypass, could provide a large separation from the main ring and a straight orbit nearly one kilometer in length. However, the small bending radius, low-symmetry geometry and strong unity superperiodicity present in such a bypass will lead to fairly tight tolerances on the structure parameters. The transfer of the beam from the main ring to the bypass should present no serious problems and several methods can be envisaged which require no appreciable departure from known techniques. (auth)

32243 (CEAL-2000, pp 46-8) LINOTRON: A PROPOSED SYSTEM OF PARTICLE ACCELERATION. Kolomenskii, A. A. (Akademiya Nauk SSSR, Moscow. Institut Fiziki).

A new system of particle acceleration, called a linotron, is proposed. It consists of a linear accelerator with standing for travelling waves and constant-field magnet channels (reflectors). In contradistinction to ordinary practice, particles are accelerated in the linear accelerator of the linotron repeatedly, traversing it alternately in opposite directions. As a result, particles acquire an energy several times greater than the nominal energy of the linear accelerator, whereby in principle the beam intensity remains high. There is developed a theory of particle motion in a linotron in the resonance mode of acceleration with variable harmonic number. An estimation is given of possible sets of parameters and the required tolerances. (auth)

32244 (CEAL-2000, pp 49-53) SEPARATED FUNCTION SYNCHROTRONS. Danby, G. T.; Allinger, J. E.; Jackson, J. W. (Brookhaven National Lab., Upton, N. Y.).

A separated function magnet lattice for a very high energy synchrotron has many very desirable features. In operation it can easily provide accurate control of the horizontal and vertical ν values over the aperture. With high intensity acceleration and extraction of external beams with small losses required such control is absolutely necessary to avoid trouble caused by couplings and nonlinear resonances. The flexibility is very valuable also in injection studies, particularly where high intensity phenomena are present. At injection the ν value is widely controllable, permitting quantitative studies of space charge effects, etc. This property is very valuable in the design stage also. Less conservative aperture choices can be considered since low ν injection studies facilitate equilibrium orbit correction. The decoupling of the quadrupole and dipole fields makes practical a wider range of choice of the design ν values. After operating experience was gained on such a machine the ν values could be raised at modest cost if desired. The existence of optically good fields for injection at lower momentum also provides additional flexibility in decisions on injection schemes. The separated function lattice is superior for possible future direct substitution of elements by their air core equivalents. The peak fields are lower for a given peak momentum. The mechanical distortions of superconducting or cryogenic coil configurations due to the large forces produced are less serious in their optical aberrations for an element of a single multipolarity. An interesting possibility is simply replacing the original exciting coils of the iron dipole magnets by a superconducting or cryogenic exciting coil package. This gives 50% higher peak fields with only moderate aberrations present. The advantages in precision optical properties and shielding of the iron cores are retained, and the stored energy is comparatively modest. (auth)

32245 (CEAL-2000, pp 54-7) THE GERMAN 40-GeV PROTON SYNCHROTRON. Heinz, W. (Kernforschungszentrum, Karlsruhe (West Germany)).

This accelerator is designed for an energy of 40 GeV and an intensity of 10^{12} protons/sec in the extracted beam. The repetition rate with a flat top of 0.4 sec is 1/sec and up to 2/sec without. The injector consists of a linac (30 MeV) and a booster (2 GeV). The booster is a 3-ring synchrotron with common magnet units and a separated function lattice. The main synchrotron operates with combined function magnets. It has 8 long straight sections, 4 for the 12 rf cavities and 4 for injection, fast and slow ejection. Its mean radius is 150 m, the mean radius of the booster 50 m. To get an economic accelerator a design was chosen that allows reducing the size of the magnets: (a) The beam is observed during acceleration and closed orbit displacements are corrected, (b) a booster synchrotron brings the protons near to the velocity of light. The magnet aperture can be small (4×8 cm^2). Size and weight of the magnets and the total stored energy is reduced. There is no need of an expensive ring tunnel. The frequency modulation in the main synchrotron is small. Space charge effects are less important. The main synchrotron is a simple but powerful accelerator, the booster is more complicated but works at moderate power level. (auth)

32246 (CEAL-2000, pp 58-63) THE CERN INTERSECTING STORAGE RING PROJECT. Johnsen, K. (European Organization for Nuclear Research, Geneva (Switzerland)).

A general description of the CERN ISR storage ring is presented which includes the design parameters expected. Other aspects discussed are beam transfer, buildings and time schedule, and cost. (B.G.D.)

32247 (CEAL-2000, pp 64-76) STATUS REPORT ON THE ORSAY ELECTRON-POSITRON STORAGE RING. (Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire).

A status report is presented which covers the work done since September 1966. Topics include injection rate of positrons, single weak beam properties, single strong beam properties, beam-beam incoherent effects, improvements on vacuum, machine facilities and beam properties relevant to high energy physics, figure of merit of a colliding ring for a given experiment, and results of high energy physics obtained with ACO. (B.G.D.)

32248 (CEAL-2000, pp 77-84) PERFORMANCE CAPABILITIES OF PROTON STORAGE RINGS. Keil, E.; Sessler, A. M. (European Organization For Nuclear Research, Geneva (Switzerland)).

The performance capabilities of proton storage rings which intersect horizontally at a small angle were evaluated. The following effects were taken into account: phase space density available from accelerators; beam-beam interactions and the single beam incoherent transverse space charge effect; low β sections and practical limitations in their design; restrictions in the momentum spread imposed by experiments; and properties of alternating gradient structures including wavelength, momentum compaction, relations between gradient and Q values, gradient and aperture, closed orbit distortions due to magnet misalignments. An optimization of the luminosity based on beam-beam interactions yields explicit formulas for all important storage ring parameters. Examples for storage rings at various energies are given. (auth)

32249 (CEAL-2000, pp 85) STACKING IN PROTON STORAGE RINGS WITH MISSING BUCKETS. Schnell, W. (European Organization for Nuclear Research, Geneva (Switzerland)).

The circumference of the CERN Intersecting Storage Rings is larger than the circumference of the injector synchrotron. Therefore, only part of the ISR circumference is filled at each injection. The filling factor decreases even further with the multiturn injection schemes that have been proposed recently. In order to obtain maximum stacking efficiency in spite of the partial filling, it is proposed to modulate the otherwise sinusoidal, radio frequency voltage in such a way that the rf buckets that do not contain particles are suppressed, all other buckets remaining unchanged. The obvious difficulty with this scheme is that of generating a chopped rf wave in a high voltage, high-Q cavity and it would, indeed, be difficult to chop the rather large rf voltage that is required at injection into the ISR. However, suppression of the empty buckets is only required towards the end of the stacking cycle when the rf voltage is rather low since one has to generate buckets that fit tight around the bunches. Some of the technical problems of this scheme are discussed and first results are presented. (auth)

32250 (CEAL-2000, pp 86-9) RECENT EXPERIMENTS WITH THE CERN ELECTRON STORAGE AND ACCUMULATION RING (CESAR). Huebner, K.; Jones, E.; Koziol, H.; Magnani, L.; Pentz, M. J.; Ruggiero, A. (European Organization for Nuclear Research, Geneva (Switzerland)).

Since the last report on work done with CESAR (Symposium on Storage Rings, Saclay, Sept. 1966) most of the time has been devoted to the study of coherent transverse oscillations. Spectra, thresholds and growth times of resistive wall instabilities have been investigated as a function of beam intensity and the external impedance connected to the clearing field electrodes. Beam splitting by a third order resonance has also been studied. Stacking with phaselock has been tried out and the influence of rf noise on stacking could thereby effectively be reduced. The possibility of increasing the average density in a stack by a stack shaping method, using rf phase displacement to cut away the tail of a stack has been demonstrated. At present (May 1967) CESAR is shut down to install combinations of sputter-ion and sublimation pumps, which should improve the vacuum to below 10^{-10} torr. Accordingly a half life-time of the electrons of about 20 sec. is expected, allowing the investigation of high order instabilities with long growth times ($\sim 10^8$ revolutions). Also before this conference it is foreseen to do "missing bucket" stacking experiments, where one of the two accelerating buckets is suppressed. (auth)

32251 (CEAL-2000, pp 99-101) INTERACTION OF A BEAM OF CHARGED PARTICLES WITH SELF FIELD. Chien, C. S. (Argonne National Lab., Ill.).

A general method has been formulated to study a beam of charged particles interacting with the field of itself. The Liouville theorem can be written in the form $i(\partial/\partial t)\ \Psi(p,q,t) = L\ \Psi(p,q,t)$, where $\Psi(p,q,t)$ is the distribution function in phase space and the operator L is $L = -i[(\partial H/\partial p)(\partial/\partial q) - (\partial H/\partial q)(\partial/\partial p)]$. It can be shown that L is a Hermitian operator. This gives us a great advantage in studying the dynamical problems in terms of operators in Hilbert space. Because of the linear character of Eq. (1), the superposition principle can be used. In the case that energy is a continuous spectrum in classical physics instead of the discrete spectrum found in quantum mechanics, we can, however, find a proper set of eigenfunctions. For an interaction system, the operator L consists of two parts corresponding to the unperturbed and perturbed Hamiltonians. The evolution of Ψ can be derived by means of operator algebra. For the interaction of a beam with self-field, the perturbed Hamiltonian must be found by the initial distribution function and the solution of the Maxwell equations with boundary conditions. No more information is needed than the specification of the initial state. The method is self-consistent. (auth)

32252 (CEAL-2000, pp 102-3) 3.5-GeV ELECTRON-POSITRON COLLIDING BEAM MACHINE VEPP-3 AT NOVOSIBIRSK. Budker, G. I.; Protopopov, I. Ya.; Skrinskii, A. N. (Akademiya Nauk SSSR, Novosibirsk. Institut Yadernoi Fiziki).

Main parameters of 3.5 GeV electron-positron storage ring which is under construction are given. Test results on models and first elements of storage rings are presented. Status of machine on June 1967 is reported. (auth)

32253 (CEAL-2000, pp 104-11) DESIGN OF A 3-GeV ELECTRON-POSITRON DOUBLE STORAGE RING. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)).

A DESY study group has prepared a proposal for a 3-GeV electron-positron double storage ring as a possible extension of the DESY facilities. The two rings are mounted one above the other with two vertical beam crossings, offering the following advantages as compared to a single ring structure: electron-electron interactions can also be studied, long-range forces between beams are eliminated, rf-phases can be adjusted independently, distributed electrodes for beam separation are eliminated, and magnet gap height is reduced such that C-type magnets become feasible, permitting a simplification of vacuum problems. The rings have a separate function magnet structure, consisting of 16 magnet periods and 2 long straight insertions with low-β interaction points ($\beta_v = 0.025$ m). The ring acceptance is 8 mrad · cm horizontally and 2 mrad · cm vertically at a momentum spread of ±0.5%. At 3 GeV, the current is limited by RF power of 2 × 1 Ampere, giving a design luminosity of about $5 \cdot 10^{32}$ cm^{-2} sec^{-1}. The storage rings will be filled from the DESY synchrotron, but direct injection from the new 400-MeV linac is also possible. (auth)

32254 (CEAL-2000, pp 112-18) THE COLLIDING BEAM PROJECT AT THE CAMBRIDGE ELECTRON ACCELERATOR. Hofmann, A.; Little, R.; Mieras, H.; Paterson, J. M.; Robinson, K. W.; Voss, G. A.; Winick, H. (Cambridge Electron Accelerator, Mass.).

The Cambridge electron synchrotron will be used not only as a 6-GeV electron accelerator but also as a storage facility for electron and positron beams with energies up to 3.5 GeV. The ring will be filled in a multicycle injection mode, in which the synchrotron field cycles at 60 cps between values corresponding to the injection energy of 0.13 and 3.0 GeV. After filling, the ac component of the synchrotron magnet power is turned off and the dc value adjusted to the desired energy. The counter rotating electron and positron beams are then switched into a bypass, in which they are made to collide in a low β interaction region. Luminosities at 3 GeV should be larger than 10^{31} cm^{-2} s^{-1} with currents of 100 mA peak (50 mA average) in each beam. A status report of this project, which started at the beginning of 1966, is given and results of first beam storage tests are described. Also the effect of outgassing in the synchrotron due to synchrotron radiation has been measured in the range from 1 to 5 GeV at base pressures in the low 10^{-9} torr range and found to be tolerable. (auth)

32255 (CEAL-2000, pp 119-22) A DESIGN OF THE CEA COLLIDING BEAM BYPASS. Mieras, H.; Voss, G. A. (Cambridge Electron Accelerator, Mass.).

A bypass to the synchrotron is under construction at the CEA which, in conjunction with the synchrotron operated as a dc storage device, will provide an electron-positron colliding beam facility. The bypass spans ⅕ of the synchrotron and extends a maximum of 2.5 m from the synchrotron. The essential feature is a long (2.5 m) straight section with low beta at the center (the interaction region). The two beams are electrostatically separated everywhere except at the interaction region, where they intersect with zero crossing angle. Design requirements are: adjustment of additional path length to an exact multiple of an rf wavelength; minimization of radiation losses; matching of betatron phase space and the momentum vector to the synchrotron, while maintaining reasonable nu values. The bypass can be tuned for a wide range of values of beta at the interaction region. A practical lower limit on beta of 5 cm in both planes is set by field requirements (14 kG) on the poles of the quadrupoles adjacent to the interaction region, and by the tight tolerances on the fields of these quadrupoles (.05%)—both due to the large values of beta (250 m) introduced at these locations. Tuneup involves steering so as to restore the original orbit in the synchrotron after the first traversal through the bypass; tuning two (out of six) pairs of quadrupoles to obtain the correct phase change through the bypass; adjusting rf frequency to correct for any error in path length; and measuring beam cross section by means of synchrotron radiation. (auth)

32256 (CEAL-2000, pp 123-5) DESIGN AND PERFORMANCE OF THE DAMPING SYSTEM FOR BEAM STORAGE IN THE CAMBRIDGE ELECTRON ACCELERATOR. Hofmann, A.; Little, R.; Paterson, J. M.; Robinson, K. W.; Voss, G. A.; Winick, H. (Cambridge Electron Accelerator, Mass.).

In order to store electrons in the Cambridge Electron Accelerator the radiation antidamping of the radial betatron oscillation has to be corrected. Two dc powered damping magnets which transfer damping from the synchrotron oscillation to the betatron mode have been constructed. Their field has a steep gradient with a characteristic length of 1.65 cm and the field strength at the operation point is 1.9 times larger than in the synchrotron magnets. Each damping magnet has 5 pole pairs with alternating polarity in order to avoid overall bending of the beam and to minimize focussing effects. These magnets have been installed in two adjacent straight sections of the synchrotron. During ac filling the beam is protected at injection-energy by a magnetic shield, and at high energy the beam is moved into the damping field by the ac beam bump. To store the beam, the ac component of the synchrotron magnets is turned off and a dc beam bump is turned on to keep the beam permanently in the damping field. The influence of various operation parameters on the lifetime of the stored beam has been investigated. The r-values and the horizontal beam size have also been measured during storage. (auth)

32257 (CEAL-2000, pp 126-9) EXPERIMENTAL INVESTIGATIONS OF BEAM-BEAM INTERACTION IN STORAGE RINGS. Auslender, V. L.; Dikanskii, N. S.; Kulipanov, G. N.; Mishnev, S. I.; Popov, S. G.; Pupkov, Yu. A.; Skrinskii, A. N.; Tumaikin, G. M.; Shatunov, Yu. M. (Akademiya Nauk SSSR, Novosibirsk. Institut Yadernoi Fiziki).

Experimental results on beam-beam interaction in storage rings VEP-1 and VEPP-2 are presented. Interaction effects lead to decrease of storage rate in the presence of second beam, to coherent beam interaction and excitation of non-linear resonances which increase transversal beam size, decrease beam life time and result in decrease of luminosity. Dependence of interaction efficiency on beam currents at various energies is investigated. Dependence of beam life time at interaction on betatron oscillation frequency is given, influence of interaction geometry on efficiency is shown. The methods of suppression of interaction effects are considered. (auth)

32258 (CEAL–2000, pp 130-4) STORAGE RING FOR 100-MeV ELECTRONS. Grigorev, Yu. N.; Grishaev, I. A.; Dovbnya, A. N.; (and others) (Akademiya Nauk Ukrainskoi SSR, Kharkov. Fiziko-Tekhnicheskii Institut).

Main parts and characteristics of the PHTI Ukr. Ac. Sci. storage ring for 100-MeV electrons are described. The results of the storage ring start-up in a quasi-betatron and synchrotron operation and investigation results for the main parameters of the stored beam are presented. (auth)

32259 (CEAL–2000, pp 135-43) TRANSVERSE COHERENT BEAM PHENOMENA IN COLLIDING BEAM DEVICES. Pellegrini, C. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati); Sessler, A. M. (European Organization for Nuclear Research, Geneva (Switzerland)).

A general formalism is developed for the analysis of the transverse coherent motion of beams in a strong focusing storage ring. Both coherent and incoherent forces arising from either direct or wake fields are included in the analysis. The beams, in the absence of coherent motion, may move along different orbits which have both time and/or space crossings. The analysis applies to beams with arbitrary longitudinal density variation. The well known results for a single coasting or bunched beam, but now generalized to include the relatively minor influence of an AG structure, are derived. Previous results for two bunched beams which were strongly dependent on the assumed azimuthal symmetry of the machine, are now significantly modified. The analysis leads to simple ways of evaluating the coherent motion, for any given structure, and for bunched (electron) and unbunched (proton) beams. One interesting result is that for a suitable choice of the number of bunches and of the Q-value, all coherent modes are stable. The analysis also shows that a strong beam with a small coherent amplitude, can drive a weak beam to large amplitude. (auth)

32260 (CEAL–2000, pp 144-7) EFFECTS OF CROSSING ANGLE ON INTERACTION RATE OF COLLIDING BEAMS. Barber, W. C. (Stanford Univ., Calif.); O'Neill, G. K. (Princeton Univ., N. J.); Gittelman, B.; Richter, B. (Stanford Linear Accelerator Center, Calif.).

Crossing angles of 1.6, 2.3 and 3.0 milliradians were used in electron–electron scattering runs at 556 MeV per particle. The data-collection rate was sufficiently high (up to one count per minute for scattering events at greater than 30° polar angle) so that several thousand events were obtained which could be subdivided according to the currents in the two beams. As was expected, vertical instabilities were sharply suppressed by the use of a crossing angle. At 3.0 milliradians the apparent beam height inferred from the length of the interaction diamond was less than 70 microns even for both beam currents over 50 milliamperes. The interaction rate as a function of the current product will be discussed in terms of possible coherent motion. (auth)

32261 (CEAL–2000, pp 148-9) RADIATION EFFECTS IN MULTICYCLE INJECTION. Robinson, Kenneth W. (Cambridge Electron Accelerator, Mass.).

The number of positrons which can be injected per cycle of the multicycle filling, is dependent on the useful aperture outside the region which must be allowed for the circulating beam. The width of the circulating beam is determined by the damping and quantum effects of the synchrotron radiation. The equations for the variation of the oscillation amplitudes during multicycle operation are obtained, and equilibrium solutions are calculated for some operating conditions, and the necessary allowed widths for the circulating beam are determined. The optimum maximum energy of the multicycle operation appears to be in the range 2.5 to 3.0 GeV. (auth)

32262 (CEAL–2000, pp 150-2) THE SPACE-CHARGE INTENSITY LIMIT IMPOSED BY COHERENT OSCILLATION OF A BUNCHED SYNCHROTRON BEAM. Laslett, L. Jackson (California Univ., Berkeley. Lawrence Radiation Lab.); Resegotti, L. (European Organization for Nuclear Research, Geneva (Switzerland)).

The intensity limitations imposed by transverse space-charge effects in circular particle accelerators have been analyzed previously, by L. J. Laslett (BNL 7534 324(1963)) with emphasis on the very significant contribution that image fields can make to the net electrical and magnetic fields acting on the particles of the beam. In that work a distinction was made between the boundary conditions applied to the dc component of the net magnetic field at ferromagnetic pole surfaces and those applied to the ac component of the magnetic field at the walls of a conducting vacuum chamber. In addition, it was suggested that both the response of a single particle to the fields of an undisturbed beam and the coherent response of the beam as-a-whole to its image fields warrant consideration in estimating transverse space-charge intensity limits. If this latter coherent effect leads to unstable oscillations, for example due to a half-integral resonance, particular care must be employed in evaluating the respective effects of the ac and dc fields, since not only the bunch structure of the beam but also the beam oscillations will give contributions to the alternating component of the field. A formula for the space-charge limit imposed by coherent motion under such circumstances is presented. This formula constitutes a revision of one proposed previously by one of us and is considered of importance because the effect described by this formula may represent one of the more stringent potential intensity limitations in high-energy synchrotrons. (auth)

32263 (CEAL–2000, pp 153-6) PHASE ACCEPTANCE IN LINACS. Gluckstern, R. L. (Massachusetts Univ., Amherst).

The usual analytic calculation of phase acceptance in linear accelerators assumes no acceleration, and numerical orbit computations are performed to determine the effect of acceleration. An analytic calculation of the phase acceptance with acceleration which is in reasonable agreement with previous orbit computation results is presented. One starts with the Hamiltonian for the longitudinal motion and finds the change in the oscillation energy during acceleration. Graphical results are presented for the effect, which is shown to depend only on the fractional change of the velocity per cell. The increased longitudinal phase acceptance is also interpreted in terms of an effective injection velocity which is somewhat higher than the actual one. The presence of high space charge forces is shown to further enhance the increase in longitudinal phase acceptance due to acceleration. (auth)

32264 (CEAL–2000, pp 157-61) TRANSVERSE BEAM QUALITY IN LINACS, AS AFFECTED BY COUPLINGS AND NONLINEARITIES, MISALIGNMENTS, AND ERRORS, AND SPACE CHARGE. Gluckstern, Robert L. (Massachusetts Univ., Amherst).

The effects of couplings, misalignments and space charge on the transverse beam dynamics are reviewed, with the following conclusions: I. Couplings and Non-Linearities: (a) Transverse-longitudinal coupling leads to apparent beam growth. (b) Coupling of the two transverse directions in quadrupole fringing fields and higher multipole fields leads primarily only to beam rotation. II. Misalignments and Errors: (a) Random transverse magnet position and angle errors lead primarily to beam displacement, but also to apparent beam growth because of simultaneous transverse-longitudinal coupling. (b) Random axial rotation errors and errors in magnetic field strength lead to apparent beam growth. III. Space Charge: (a) Space charge forces (except for image forces) do not lead to changes in the transverse oscillations of the beam as a whole, or to changes in the displacement of the beam due to magnet position and angle errors. (b) Space charge forces can lead to a substantial increase in the longitudinal and transverse oscillation wave lengths of individual particles. (c) The beam growth due to misalignments with coupling, axial rotation errors and magnetic field strength is increased by the increased oscillation wave length. (d) The beam growth due to transverse-longitudinal coupling depends on the corresponding space charge coupling term. Comparison is made with numerical orbit computations. (auth)

32265 (CEAL–2000, pp 162-6) LONGITUDINAL SPACE CHARGE EFFECT IN PROTON LINACS. Nishikawa, T.; Okumura, S. (Tokyo Univ. (Japan)).

Space charge effects on the longitudinal phase motions with accelerations in proton linacs have been studied both by an analytic approximation and a computational method. The phase orbits obtained from the linearized approximation show good agreements to those calculated by computers if the space charge effect is moderate. The space-charge-limited current can also be evaluated from the analytic method based on the uniformly-charged ellipsoidal-bunch model. The discrepancy between the ellipsoidal model and the Boltzmann-distribution model, which was pointed out by Bondarev and Vlasov at the Fifth High Energy Accelerator Conference, can be explained by taking the effects of bunch center and exterior potential into considerations. The effects of acceleration and different charge distributions have also been examined leading to the good agreements to the computational results. (auth)

32266 (CEAL-2000, pp 174-8) REAPPRAISAL OF DESIGN CRITERIA AT THE LOW-ENERGY END OF PROTON LINAC INJECTORS. Montague, B. W. (European Organization for Nuclear Research, Geneva (Switzerland)).

The high intensities required for present and future A.G. proton synchrotrons introduce severe space-charge and coupling problems at the low-energy end of the linac injector. Conditions are improved if the acceleration frequency for the first few MeV is a subharmonic of the normal linac frequency. The choice of an even subharmonic makes possible the use of two or more low-energy linacs injecting in parallel into a single main linac, leading to a large increase in available intensity. For reasons of space, economy, and high-intensity performance, the helix accelerating structure offers several advantages at low energies. A review of assumptions concerning phase trapping shows that favorable conditions of radial motion in a helix can be achieved comfortably with conventional quadrupole focusing. It is concluded that the application of these principles, together with some previous proposals, will lead to an increase in linac intensity by at least a factor of two over the best performance to date. (auth)

32267 (CEAL-2000, pp 179-82) PROPOSED LAYOUT FOR THE 45-GeV SYNCHROTRON PROJECT EXPERIMENTAL AREAS. Cartier, A.; Parain, J.; de Sereville, B.; Tardy-Joubert, P. ([Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires]).

The external beam can be transported at large distances, using a periodic structure having a unity transfer matrix for the conservation of optical properties. The beam can be split between various main users. This solution seems perferable in comparison with the extraction of beams from various parts of the accelerator. The beam transport in tunnels underground is justified by costs examination of civil engineering connected with requirements for the shielding. The same conclusion can be applied to the target station: the targets will be placed in a room under several meters of earth with an end wall in movable concrete blocks. The secondary beams pass through the wall and can be used on an open air area. At these large distances, the ground motions must be compensated by an automatic device on the magnets and quadrupoles. (auth)

32268 (CEAL-2000, pp 183-9) TARGET STATIONS IN HIGH-ENERGY EXTERNAL PROTON BEAMS. King, N. M.; Wilson, E. J. N. (Rutherford High Energy Lab., Chilton (England)).

The problems of targeting in a 300-GeV external proton beam are considered, and target stations allowing flexible development of zero-degree secondary beams are outlined. To permit maximum exploitation, special small-aperture Sandwich Magnets are proposed. Shielding is provided in the form of specially designed remotely controlled collimators which do not conflict with the basic requirements of versatility in selecting secondary momenta. (auth)

32269 (CEAL-2000, pp 190-6) THE NEW THREE CAVITY RF SEPARATOR OF CERN. Bernard, P.; Lazeyras, P.; Lengeler, H.; Vaghin, V. (European Organization for Nuclear Research, Geneva (Switzerland)).

The principle of operation of a three cavity rf separator using linearly polarized deflection fields is discussed. The advantages of two contaminant rejection over a two cavity system are indicated and separation curves for kaons, pions and antiprotons are given. The new CERN separator can separate kaons up to 16 GeV/c, antiprotons and pions up to the highest momenta that are possible with the CERN PS. A short description of the general layout, the main parameters and some technical aspects are given. Furthermore, the tuning procedure and experimental results of a 12 GeV/c antiproton run are described. The extension of this type of separator to higher energies is discussed. (auth)

32270 (CEAL-2000, pp 197-8) ON THE RF SEPARATION OF PARTICLES WITH ENERGIES UP TO 1 TeV. Valdner, O. A.; Glazkov, A. A. (Moskovskii Inzhenerno-Fizicheskii Institut (USSR)).

Theoretical studies were performed on the possibility of using the rf method of separation of secondaries from the 1000-GeV cybernetic accelerator. The following items were considered: particle dynamics in the waveguide with transversal deflection; optimization of separator parameters; rf and optical tolerances; three-component separation etc. A design study was undertaken for the main systems of the beam separator. The study included impulse extraction of particles from the accelerator, magnetic focusing, vacuum and rf systems, and engineering equipment of the separator channel. The momentum of kaons being 140 GeV/c, of antiprotons 280 GeV/c, each waveguide is 8 m long; input power 3 Mwt (pulse); wavelength 3.2 cm; transverse momentum of kaons 21.4 MeV/c. (auth)

32271 (CEAL-2000, pp 199-209) THE 300-GeV ACCELERATOR IN THE EUROPEAN PROGRAMME FOR HIGH-ENERGY PHYSICS. Amaldi, Edoardo ([European Organization for Nuclear Research, Geneva (Switzerland)]).

The structure of the European Committee for Future Accelerators (ECFA) and the procedures that the ECFA itself has adopted for arriving at its conclusions are briefly discussed. Results of a study of the relations between universities and national laboratories and the international laboratories are presented. Finally, the main features of the 300-GeV accelerator and its utilization are examined. (B.G.D.)

32272 (CEAL-2000, pp 210-20) SOME ASPECTS OF THE 200 GeV ACCELERATOR. Wilson, Robert Rathbun (National Accelerator Lab., Oak Brook, Ill.).

A general review of the design characteristics of the 200-GeV proton synchrotron to be built in the USA is presented. Topics discussed include general layout of injector, booster, and main ring; variability of maximum energy, magnet design, support mechanism, linac, booster synchrotrons, and experimental facilities. A table including some of the design parameters is also included. (B.G.D.)

32273 (CEAL-2000, pp 248-54) SERPUKHOV 70 GeV PROTON SYNCHROTRON. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Akademiya Nauk SSSR, Moscow. Radiotekhnicheskii Institut).

The progress in the construction of the Serpukhov 70-GeV proton synchrotron is outlined. Some details of tuning different systems of the accelerator are described. (auth)

32274 (CEAL-2000, pp 255-60) INJECTOR FOR THE SERPUKHOV PS: START-UP WORKS. Mints, A. L.; Kapchinsky, I. M.; Nevyazhsky, I. Kh.; (and others) (Akademiya Nauk SSSR, Moscow. Radiotekhnicheskii Institut. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii).

The procedures of starting-up the 100-MeV proton linear accelerator is reported. Experimental performances of cavities, drift tubes, and electronic systems are given. Procedures used for vacuum conditioning of the cavities and drift-tube adjustment techniques are described. Results of rf excitation of the cavities along with parameters of the beam monitoring system are included. (auth)

32275 (CEAL-2000, pp 261-9) VOLTAGE GRADIENT MEASUREMENTS IN THE ARGONNE INJECTOR LINAC UNDER BEAM LOADED AND TRANSIENT CONDITIONS. Lewis, Lloyd G.; Knott, Martin J.; Perry, Rolland; Abraham, Joseph; Castor, Richard W.; Myers, Willis W. (Argonne National Lab., Ill.).

Pick up loops and associated linear detectors were mounted in ports located along the length of the Zero Gradient Synchrotron (ZGS) injector linac. The voltage induced in each loop by the linac magnetic field produced a detector output voltage that was fed to the ZGS monitor and control computer system. Sample and hold amplifiers, multiplexers, and analog to digital converters provided readings from the detectors at computer specified times. Each detector was calibrated by mounting it in port number 28 and comparing its output to that of a reference detector mounted in port number 30. Removal of a detector and reinstallation in the same port produced changes in readings of 0.6%. Interchanging two detectors indicates that variations in the geometry of the ports produce changes of about 2% in the detector sensitivity. Measurements taken during cavity filling time show transient wave propagation in the cavity. Measurements taken during acceleration show beam interactions that change the transient waves. Loading by a 20 milliampere beam reduced the voltage gradient at the ends of the cavity less than 1% when automatic level control feedback was used. Output from the computer can operate an x-y plotter and a digital cathode ray tube display. (auth)

32276 (CEAL-2000, pp 270-4) MEASUREMENT OF PHASE SHIFT DUE TO BEAM LOADING IN AN ALVAREZ-TYPE LINAC. Perry, Rolland; Abraham, Joseph (Argonne National Lab., Ill.).

One of the effects of heavy beam loading in a proton linac is the change in rf electrical phase (or frequency) with the onset of beam.

A method has been developed for examining the shift in arrival time of the individual beam bunches due to variations in beam intensity in the linac. The corresponding shift in the rf phase (200 MHz) is measured by observing the output of magnetic coupling loops at the cavity walls. The signal produced by a beam bunch is fed directly to the vertical plates of a wide band CRO, the sweep of which is triggered by a 200 MHz stable oscillator signal. Multiple traces of the CRO are recorded on film during a single linac beam pulse by operating the CRO in the free-run mode while displacing the trace vertically at a uniform rate. A description of the system is given, together with quantitative results as a function of linac beam current. (auth)

32277 (CEAL–2000, pp 284-8) LONGITUDINAL INSTABILITY IN THE PRESENCE OF AN RF FIELD. Lebedev, A. N. (Akademiya Nauk SSSR, Moscow. Institut Fiziki).

The stability of coherent synchrotron oscillations in rf bunched beams is investigated. The proposed method makes it possible to consider from a single viewpoint beam-cavity interaction and negative mass and resistive wall instabilities. The stability of various modes of coherent synchrotron oscillations in the presence of finite-Q cavity is investigated. The existence of negative mass instability in rf bunched beams is proved and the corresponding threshold number of particles is determined. (auth)

32278 (CEAL–2000, pp 289-94) COLLECTIVE LINEAR ACCELERATION OF IONS. Veksler, V. I.; Sarantsev, V. P.; Bonch-Osmolovskii, A. G.; (and others) (Joint Inst. for Nuclear Research, Dubna (USSR)).

The report is devoted to theoretical consideration and experimental proof of a possible construction of an accelerator based on a new collective principle of acceleration, suggested by V. I. Veksler. Methods are considered for producing a bunch with a large number of particles, accelerating it and keeping its size constant. From the calculations of the bunch stability definite conditions are deduced, for particle concentration as well as for external electromagnetic fields, under which it is possible to obtain the bunch of optimum size. The experiments performed completely agree with calculation data. Consideration of different methods of keeping the size of the bunch constant makes it possible to choose the most effective and economically advantageous one, which is realized by the accelerator model. The choice of accelerating system is well-grounded. The calculations of effective electrical fields for this system are carried out. It is shown that these fields exceed considerably those obtained at present in operative accelerators. (auth)

32279 (CEAL–2000, pp 295-9) STRONG FOCUSING RING CYCLOTRON FOR MULTICHARGED IONS. Dzhelepov, V. P.; Dmitrievskii, V. P.; Zamolodchikov, B. I.; Kolga, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR)).

A possibility of using a strong focusing cyclotron for accelerating multiply charged ions is considered. The accelerator consists of a ring magnetic system which provides strong focusing along two orthogonal axes and the isochronism of closed orbits; of the accelerating system – resonance cavities operating at constant frequency, and the injector-accelerator of a tandem of Walton-Cockcroft type. The strong focusing cyclotron can be successfully used to accelerate ions having the mass number $A > 40$ up to 6-8 MeV/nucleon. Another version of the above cyclotron allowing the secondary cycle of acceleration is also considered. In this case energy per nucleon is increased $(Z_2/Z_1)^2$ times, where $(z_2 - z_1)$ is the increment of the ion charge before the secondary cycle. The sizes of the ring area of the magnetic field are decreased in this case several times. The calculations of the cylotrons are given, the maximum diameter being 10 and 4 m, respectively. The advantages of the proposed accelerators are that they reduce limitations due to the space charge and lessen requirements to the vacuum system. (auth)

32280 (CEAL–2000, pp 300-2) NON-LINEAR MULTI-TURN INJECTION OF PARTICLES INTO CIRCULAR ACCELERATORS. Globenko, Yu. G.; Zenkevitch, P. R. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki).

It is proposed to use the artificially created resonance harmonics of nonlinearity for multi-turn injection into circular accelerators. The efficiency of multi-turn injection by means of the fourth-order nonlinear resonance is investigated. This calculation is carried out by numerical calculation of particle motion solution in amplitude-phase plane. Results are presented in form of diagrams. (auth)

32281 (CEAL–2000, pp 303-14) DUBNA 700-MeV HIGH-INTENSITY PHASOTRON. Glazov, A. A.; Denisov, Yu. N.; Dzhelepov, V. P.; (and others) (Joint Inst. for Nuclear Research, Dubna (USSR)).

A design of the Dubna synchrocyclotron conversion into a small meson factory having 700-MeV proton energy and the mean beam current up to 50 μA (i.e., 3×10^{14} p/sec) is presented. (B.G.D.)

32282 (CEAL–2000, pp 315-19) FOUR-RING VERTICALLY STACKED 800-MeV BOOSTER INJECTOR FOR THE CERN PROTON SYNCHROTRON. Bovet, C.; Reich, K. H. (European Organization for Nuclear Research, Geneva (Switzerland)).

After a comparison of various possibilities like a 200-MeV linac or a single-ring booster synchrotron, a four-ring slow-cycling 800-MeV booster has been selected for a detailed engineering study mainly on account of its enhanced capabilities for feeding efficiently small targets used in separated beams and for improving the performance of the CERN intersecting storage rings. The detailed reasons for this choice are given. The main features of the design, in particular the separate function lattice, are discussed. The proposals for the magnet, injection and ejection, the rf system, the vacuum system, and the foundations and buildings, are reviewed. (auth)

32283 (CEAL–2000, pp 320-2) RECENT INJECTOR STUDIES FOR THE EUROPEAN 300-GeV ACCELERATOR: USE OF A TART INSERTION. Hardt, W. (European Organization for Nuclear Research, Geneva (Switzerland)).

Since a multiple ring synchrotron seems to be a good choice for an injector into the CERN-PS to improve its intensity, it was logical to investigate a similar possibility also for injection into the 300 GeV synchrotron. The study was concentrated on the cascade of a 60-MeV linac, 600 MeV TART, and 8 GeV booster-main ring. The result is presented in comparison with the original 300 GeV injection design, the LRL studies, and the injection into the PS. The principal advantages of the TART injection are an increased space charge limit at reduced linac current and linac energy and a significant reduction of Q_s (synchrotron oscillations per turn). A high Q_s can do serious harm, in particular under heavy traverse space charge conditions. A strong effort is justified in order to achieve a comfortable Q_s, and a TART injector type between the linac and the booster is one method, among a few, to obtain this. (auth)

32284 (CEAL–2000, pp 323-4) TWIN BOOSTER INJECTOR FOR A LARGE PROTON SYNCHROTRON. Billinge, R.; Schnell, W. (European Organization for Nuclear Research, Geneva (Switzerland)).

The choice of an injector for a large proton synchrotron is discussed. If the injector is a single rapid-cycling booster-synchrotron, its circumference must be made rather large in order to obtain a short filling time. However, the large circumference tends to lead to an uncomfortably low space-charge limit and to a dangerously high number, Q_s, of phase oscillations per revolution. A proposal is made to alleviate these difficulties by replacing the original large booster-ring by two identical rings without changing the repetition rate nor the injection and ejection energies. This scheme brings about a two-fold increase of the space-charge limit and an equal decrease of Q_s, as well as a considerable increase of operational reliability due to the parallel operation of two injectors. It is indicated that the additional cost of replacing one large ring by two half-size ones is rather modest. Tentative parameters for a twin-booster have been worked out and are presented. (auth)

32285 (CEAL–2000, pp 325-30) CRITERION FOR DESIGNING SYNCHROTRONS WITHOUT ALTERNATING-GRADIENT FOCUSING. Garren, A. A.; Hubbard, E. L. (California Univ., Berkeley. Lawrence Radiation Lab.).

In a synchrotron with large circumference factor, the smallest beam size is not obtained with alternating-gradient focusing if the circumference factor divided by the square of the number of magnets is within a certain range. Within this range, smaller betatron amplitude is obtained if the magnets all have the same gradient than if their gradients alternate. Interlaced multiple-beam injector synchrotrons, which necessarily have a large circumference factor, often satisfy this criterion. By eliminating the alternating-gradient requirement, the structure of interlaced machines can be simplified and more space provided for auxiliary equipment, while a moderate aperture still suffices. This principle is also applicable to separated-orbit-cyclotrons. (auth)

32286 (CEAL–2000, pp 330-5) PERFORMANCE OF THE NEW NEUTRINO BEAM AT THE CERN PROTON SYNCHROTRON. Bertolotto, R.; Bloess, D.; Brown, R. C. A.; (and others) (European Organization for Nuclear Research, Geneva (Switzerland)).

A new experimental area has been developed at CERN primarily for neutrino experiments, but beams of p's, π's, μ's and K's for bubble chamber experiments can also be obtained from external targets. The performance of the fast ejection system and of the external proton beam is monitored by a redundant set of instruments: fast beam current transformers, a gas Cherenkov cell, aluminium activation probes, television, and electrostatic pickup. During neutrino experiments, the performance of the secondary meson beam and of the neutrino filter is monitored by a system of ionization chambers and scintillators disposed in channels in the steel filter. Some design aspects of the neutrino area are discussed and performance results reported. (auth)

32287 (CEAL-2000, pp 336-42) RESONANT EXTRACTION OF THE PROTON BEAM FROM THE DUBNA SYNCHROPHASOTRON. Issinskii, I. V.; Kulakova, E. M.; Lysyakov, V. N.; Myznikov, K. P.; Pavlov, N. I.; Tarakanov, N. M.; Zinoviev, L. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy).

The description of the fast extraction of the proton beam from JINR synchrophasotron is presented. The jump of the particles into a deflecting magnet is due to half-integral resonance of radial betatron oscillations. It is characteristic for this method of the extraction, when the half-integral resonance is used, that with a simple technique one obtains good efficiency. The features of the external beam and the beam transport system are described. (auth)

32288 (CEAL-2000, pp 347-51) IMPROVEMENT OF THE EMITTANCE IN THE RESONANT BEAM EJECTION. Kobayashi, Y.; Takahashi, H. (Tokyo Univ. (Japan). Inst. for Nuclear Study).

An analytical theory of the resonant beam ejection was derived, and an integer and a third resonance ejection have been investigated. The beam emittance can be minimized by the use of octupole magnets in an integer resonance ejection and by a proper combination of sextupole magnets in a third resonance ejection. Examples of such schemes are reported and relative merits of each scheme are discussed. (auth)

32289 (CEAL-2000, pp 352-5) 1-GeV CYBERNETIC PROTON ACCELERATOR: MODEL OF 1000-GeV ACCELERATOR. Mints, A. L.; Vasiliev, A. A.; Dzergatch, A. I.; Sosenskii, N. L.; Batskikh, G. I. (Akademiya Nauk SSSR, Moscow. Radiotekhnicheskii Institut).

Some results of start-up works at the proton synchrotron are discussed. A general injection lay-out and characteristics of the proton beam injected are given. The methods used to transport the injected beam along the ring and to obtain the beam circulation by means of magnetic field correcting devices and the results obtained are described. The accelerating system is described along with the results of experiments on beam capture and acceleration. (auth)

32290 (CEAL-2000, pp 356-9) CHARACTERISTICS OF THE SELF-ADAPTIVE DAMPER FOR THE VERTICAL BEAM INSTABILITY IN THE ZERO GRADIENT SYNCHROTRON. Martin, J. H.; Winje, R. A.; Trendler, R. C. (Argonne National Lab., Ill.).

For about one and one-half years, an electronic device for damping the vertical beam instability has been functioning in the Zero Gradient Synchrotron. It was permitted increasing the beam intensity from 0.3 to 2.4×10^{12} protons per pulse. The characteristics of this damper have been examined in some detail. Certain initial problems had to be solved to make the device really functional. Measurements have been made of the sensitivity of the system to feedback loop gain, certain kinds of noises, involvement with certain betatron tune resonances, tolerance in delay of the damping signal voltage, and limitations in the amplitude of this voltage. (auth)

32291 (CEAL-2000, pp 360-2) BEAM MEASUREMENT APPARATUS FOR 6-GeV EREVAN ELECTRON ACCELERATOR. Karabekov, I. P.; Nazarian, Yu. R.; Martirosian, M. A. (Akademiya Nauk Armyanskoi SSR, Erevan. Institut Fiziki).

The method of the block scheme synthesis of the beam observation system is described, and some characteristics of its main parts are given. (auth)

32292 (CEAL-2000, pp 363-73) HIGH-SPEED DIGITIZED ORBIT DISPLAY FOR THE CERN PROTON SYNCHROTRON. Barbalat, O. ([European Organization for Nuclear Research, Geneva (Switzerland)]).

To achieve optimum injection of the linac beam, make Q-measurements at a few milliseconds interval, have accurate beam steering on targets and into ejection magnets, control beam loss near radiation-sensitive areas without disturbing normal operation, a Closed Orbit Digital Display (CODD) was developed. One of the main features of CODD, its high speed, reduces considerably non-systematic errors due to jitter in beam properties and will allow the use of statistical methods to analyze obtained data. The system measures the radial and vertical beam displacement by a set of 40 pick-up electrodes. At any chosen energy it samples the position of a single bunch by following it during Q + 1 betatron wavelengths. This information corresponding to an overlapped orbit is digitized and stored with a 2% resolution in less than 75 microseconds, then transferred onto an electronic data display, printed or introduced into an IBM 1800 computer. The speed is in principle sufficient for corrections within the same accelerating cycle. First measurement results are shown and future developments discussed. (auth)

32293 (CEAL-2000, pp 374-7) NONDESTRUCTIVE BEAM PROFILE DETECTION SYSTEMS FOR THE ZERO GRADIENT SYNCHROTRON. Hornstra, Fred Jr.; DeLuca, William H. (Argonne National Lab., Ill.).

Two nondestructive beam width detection systems have been devised which allow continuous observation of beam width throughout the acceleration and targeting cycle. For a signal, both systems rely upon the ionization of the residual gas at approximately 1×10^{-6} torr by the proton beam. One system consists of a phosphorized glass screen and an electrode placed above and below the beam respectively parallel to the plane of the beam. The liberated electrons are accelerated to several kv before striking the phosphorized screen. Light emitted by the phosphor gives a visual measure of the proton beam width without destroying the beam. The phosphorized screen is observed with a television camera. The second system uses a strip electrode in place of the phosphorized glass screen. In this case, the ions are collected on the strips with approximately one kilovolt. The ion current from each individual strip is amplified to yield a signal proportional to the amount of beam residing over the strip at any given time. The signals from the strips are multiplexed for an oscilloscope display. Movies of both displays show interesting and previously unobservable beam behavior which is being studied in detail. (auth)

32294 (CEAL-2000, pp 378-80) SUPERCONDUCTING ACCELERATOR PROJECT AT STANFORD UNIVERSITY. I. DESIGN PROBLEMS. Wilson, P. B. (Stanford Univ., Calif.).

Measurements on microwave test cavities have demonstrated that a superconducting electron linac is feasible in principle. Attention is now being directed to specific problems of design and technology which must be solved in order to build a fully operational superconducting accelerator. Measurements and calculations currently in progress in several areas of superconducting accelerator design are presented. Among the topics to be discussed are: the design of a suitable accelerating structure, the values of Q presently obtainable in cavities and structures, limits on the electric field strength in cavities and structures, the design of a suitable injector for a superconducting linac, and beam break-up in superconducting structures. (auth)

32295 (CEAL-2000, pp 381-2) SUPERCONDUCTING ACCELERATOR PROJECT AT STANFORD. II. THE FIVE AND FIVE HUNDRED FOOT ACCELERATORS. Chambers, E. E. (Stanford Univ., Calif. High-Energy Physics Lab.).

The test of the five foot section will be described in detail. The obvious extrapolations will be made to five hundred feet. The design operating conditions of the larger machine (2 GeV, unit duty cycle, 100 μA, and 10^{-4} energy resolution) will be discussed with particular attention to the obstacles and the prognosis. (auth)

32296 (CEAL-2000, pp 383-6) RESULTS OF A DESIGN STUDY FOR A 7 GeV SUPERCONDUCTING PROTON LINEAR ACCELERATOR. Passow, C. (Kernforschungszentrum, Karlsruhe (West Germany)).

The design study for a superconducting 7-GeV proton linear accelerator has been further pursued. Experimental work on the production of resonators with high Q-values and on the investigation of field limiting processes will be described as well as theoretical work on the problem of beam loading and of controlling the operation of a high Q linear accelerator. A cost estimate for a 100 uA CW version will be given. (auth)

32297 (CEAL-2000, pp 391-2) Nb_3-Sn COIL CONFIGURATIONS FOR ACCELERATORS. PART I. SEPARATED FUNCTION ELEMENTS. Kruger, P. Gerald; Snyder, J. N. (Illinois Univ., Urbana).

It is of interest to examine the possibility of constructing FFAG fields or other magnetic fields suitable for high-energy accelerators or storage rings, by using currently available Nb_3–Sn. This means that it is necessary to consider dipole, quadrupole and diquad elements, because all of these might be used in separated function or combined function fields in an accelerator. Calculations have been made for structures having a circular and an elliptical cross section geometry to determine the turn distribution necessary to produce the shape and uniformity of the field desired. In all cases Nb_3–Sn ribbon has been the superconductor considered. Separated functions structures may be made by suitably positioning dipole bending magnets and quadrupole (or higher pole) focusing magnets in the accelerator ring. The results of calculations on elements up to six inches in diameter and twenty-six inches long will be presented in detail. The elliptical cross section geometry is interesting for several reasons one of which is that for that geometry the cost of the necessary Nb_3–Sn is considerably less than that for a circular geometry. Calculations for bucking coils to produce effective cancellation of the magnetic field outside of the structures have been considered also. (auth)

32298 (CEAL–2000, pp 397–400) OPERATION OF THE CORNELL 10-GeV ELECTRON SYNCHROTRON. Littauer, Raphael (Cornell Univ., Ithaca, N. Y. Lab. of Nuclear Studies).

Full-cycle acceleration of particles was achieved in the Cornell 10-GeV Electron Synchrotron early in May, 1967. The magnet was powered at 60 Hz by ac from a solid-state inverter, and biased by dc; however, the use of temporary power sources limited excitation to a peak of about 2 GeV. One of four projected synacs was used for rf acceleration. The frequency (714 MHz) is the 1800th harmonic of the orbital frequency; it is also the fourth subharmonic of the frequency of the S-band linac injector. (The proposed synchronization between linac and accelerating voltages had not yet been implemented.) Apart from some radial steering at the ends of one of the 12-m straight sections, no guide-field corrections of any kind were used. Satisfactory acceptance and capture of the injected beam were demonstrated. Operation of the accelerator using the permanent utilities is planned for July and August. Details of performance will be presented. (auth)

32299 (CEAL–2000, pp 401–3) STATUS REPORT OF THE EREVAN ELECTRON SYNCHROTRON. Alikhanian, A. I.; Badalian, C. V.; Barishev, A. I.; (and others) (Akademiya Nauk Armyanskoi SSR, Erevan. Institut Fiziki).

A description of tuning methods and principal regimes of the main parts of the accelerator are presented. Information connected with performance of the power supply system is included. Emittance of the linac, the measured energy distribution and beam-matching system are discussed. A brief review is given on the method of the magnetic field correction by using the information taken from injected beam. Design parameters of the beam monitors and their operation are discussed. The main properties of the radio-frequency system which provides for transmitter maximum stable load in the case some cavities were mismatched are described. A special problem met in the time of operation was resonant discharge in the cavities. The way which was used to overcome this discharge is described here. Some problems of the vacuum system are touched upon. The analysis of the beam losses and first operation of the accelerator are given. In conclusion the brief description of the first order experiments is presented. (auth)

32300 (CEAL–2000, pp 404–7) INITIAL OPERATION OF THE ELECTRON SYNCHROTRON NINA. Crowley-Milling, M. C. (Daresbury Nuclear Physics Lab. (England)).

The special features of the 4 GeV electron synchrotron NINA are described and the initial measurements of the behavior of the synchrotron are given. A relatively high current has been accelerated to 3 GeV using the rf driver stage only, and an electron beam has been extracted. Correlation has been obtained between the magnetic field corrections needed at injection and the disturbance set up by transmission line modes on the network. Five experiments are being set up and are expected to be taking data by the middle of the year. (auth)

32301 (CEAL–2000, pp 408–13) THE 360-MeV AND 2-GeV ELECTRON ACCELERATORS OF THE UKRAINIAN PHYSICAL-TECHNICAL INSTITUTE. Artemov, V. J.; Bazaev, Yu. M.; Beloglazov, V. I.; (and others) (Akademiya Nauk Ukrainskoi SSR, Kharkov. Fiziko-Tekhnicheskii Institut).

The design, operation, and performance characteristics of the 360 MeV and 2 GeV electron accelerators of the Ukrainian Physical Technical Institute are discussed. (B.G.D.)

32302 (CEAL–2000, pp 414–18) PROGRESS REPORT ON THE AGS CONVERSION PROJECT. Wheeler, G. W. (Brookhaven National Lab., Upton, N. Y.).

The reason for the objectives of the AGS Conversion Project are reviewed. The intensity of the 30-GeV proton beam will be increased to 10^{13} protons/pulse and the magnet cycling rate increased to a maximum of one per second. The increase in intensity will be accomplished by installing a new injector in place of the 50-MeV linac. The increased cycling rate will require a larger motor-generator set and a new rf system for the synchrotron. The increased radiation levels which will be encountered will require numerous modifications to the synchrotron and increased shielding around it. Several additional experimental areas will be added. The scope of this work and the techniques for accomplishing it are discussed. The current status of the Project is reviewed. (auth)

32303 (CEAL–2000, pp 419–22) MACHINE EXPERIMENTS ON THE RING PHASOTRON OF THE LEBEDEV PHYSICAL INSTITUTE. Kazanskii, L. N.; Kanunnikov, V. N.; Kolomenskii, A. A.; Ovchinnikov, E. P.; Papadichev, V. A.; Fateev, A. P.; Yablokov, B. N. (Akademiya Nauk SSSR, Moscow. Institut Fiziki).

Beam experiments performed on the electron ring phasotron of the Lebedev Physical Institute are described. Experimental and theoretical data are compared on the peculiarities of beam behavior during injection, acceleration and stacking in a strongly non-linear magnetic field constant in time, the dependence of betatron oscillation frequencies and lifetime on energy, rf acceleration, and beam stacking in the absence of radiation etc. (auth)

32304 (CEAL–2000, pp 423–7) RADIAL BEAM INSTABILITIES IN THE ZERO GRADIENT SYNCHROTRON. Martin, John H. (Argonne National Lab., Ill.).

Since the intensity of the beam in the Zero Gradient Synchrotron has been increased by nearly one order of magnitude, difficulty has been experienced with the width of the beam in the horizontal direction increasing to objectionable values. There is no observable connection between this blowup and the functioning of the damper for the coherent vertical instability except that the damper is necessary to obtain intensities high enough for the radial blowup to occur. During the acceleration cycle it is necessary for the beam to cross a few high order betatron resonances. If the beam is programmed to cross the resonances in no more than 50 milliseconds when the guide field is about 4 kilogauss, the beam blowup can be held to a width increase of about 50%. After this, all troublesome resonances can be avoided and the beam width shrinks slightly to about 3 inches at the time of targeting. If the beam is allowed to dwell much longer near some of these resonances, it blows up rapidly to widths as great as 13 inches and some loss of intensity occurs. All evidence indicates that this blowup is incoherent and is accompanied by an incoherent vertical blowup which increases the beam thickness from about 1 to 1.3 inches. The radial blowup occurs in such a way that very few protons are left with small betatron oscillation amplitudes. (auth)

32305 (CEAL–2000, pp 445–50) PROTON UTILIZATION AT THE CERN PROTON SYNCHROTRON. Bovet, C.; Dekkers, D. (European Organization for Nuclear Research, Geneva (Switzerland)).

Before 1965 most of the protons were used for internal targeting except for one fast extraction (single turn). Then, a combined slow (integral resonance)–fast extraction was installed and later a slow extraction and a fast one out of two different straight sections. All eight beams in the East area are now derived from external targets. Two internal targets are still used in the South and North halls, for eight groups of physicists. Fast extraction has an efficiency of 80–95%. For slow extraction, the efficiency of about 50% will be improved by a thin septum lens. Work continues to reduce the time structure of the burst due to rf bunching and magnet ripple. To increase the possibilities of subsequent sharing of internal targets and extractions, power supplies with smaller rise and fall time are introduced; moreover a rapid target with servo-controlled movement will come into operation. Tests of simultaneous sharing of internal targeting (long burst) and slow extraction have also been made. The operation benefits from an increased number of reliable monitors: control of radiation levels in the ring and along extracted beams, monitors in these beams. A beginning is made with computer-controlled operation of extracted beams. (auth)

32306 (CEAL–2000, pp 451–5) PERFORMANCE OF THE ZERO GRADIENT SYNCHROTRON AT ARGONNE NATIONAL LABORATORY. Daniels, Robert E. (Argonne National Lab., Ill.).

A brief summary of the ZGS performance during the past two years and the present capabilities of the machine will be described. This will include operating efficiencies, beam handling efficiencies, magnet programs, beam monitoring, and targeting techniques. The effect on machine operations of major problems such as radiation and resonances will be reviewed, and machine improvements planned for the near future will be presented. (auth)

32307 (CEAL–2000, pp 456-9) SUMMARY OF HIGH-ENERGY PHYSICS UTILIZATION OF THE ZGS. Livdahl, P. V.; Jones, R. J.; Nordby, D. H.; Blume, L. O.; Cosgrove, D. F.; Glowacki, A. M.; Klem, R.; Roberts, E. G.; Schweingruber, F.; Siljander, W. A. (Argonne National Lab., Ill.).

A description of the experimental beams used at the ZGS for high energy physics purposes, together with their characteristics and operational compatibility, and a summary of the utilization of these beams are presented. Plans for a second external proton beam and other beams presently under consideration are discussed. (auth)

32308 (CEAL–2000, pp 460-2) ITEP PROTON SYNCHROTRON (PRESENT STATUS). Goldin, L. L.; Onosovskii, K. K.; Barabash, L. Z.; (and others) (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki).

Present operational parameters of the ITEP proton synchrotron are given. Methods used for diminution of the Coulomb effect are described. The ITEP proton synchrotron intensity has been increased up to 1.6×10^{11} proton per pulse by means of these methods. The preparation measures for a work with a new injector (linear accelerator with an energy of 25 MeV) and expected parameters of the synchrotron after the change of the injector are reported. The beam ejection system for medical purposes is described. Target efficiency and ejection by means of target perturbation widely used at the ITEP accelerator are considered. The influence of the experimental magnets and magnetic lenses placed near the accelerator on the acceleration regime is discussed. (auth)

32309 (CEAL–2000, pp 463-5) RESULTS ON HIGH-POWER MODELS OF MECHANICALLY TUNED CAVITIES FOR FAST-CYCLING BOOSTER SYNCHROTRONS. Schnell, W.; Zettler, C. (European Organization for Nuclear Research, Geneva (Switzerland)).

The problem of rf acceleration in a fast cycling proton synchrotron is a difficult one because of the combination of a large frequency swing with a large required voltage. Several years ago rf cavities equipped with servo-controlled mechanical tuners have been proposed for this purpose Meanwhile, two full-size high-power models of such cavities have been built and undergone extensive testing. The results are presented. (auth)

32310 (CEAL–2000, pp 474-7) LONGITUDINAL SPACE-CHARGE FORCES AT TRANSITION. Soerenssen, A. ([European Organization for Nuclear Research, Geneva (Switzerland)]).

A few facts and problems concerning longitudinal space-charge forces at transition are presented The methods for compensating for it are discussed. Most of the material was taken from listed references, but some material which has not been written in the form of reports are included. (auth)

32311 (CEAL–2000, pp 478-81) COUPLING BETWEEN BETATRON AND SYNCHROTRON OSCILLATIONS DUE TO INCOHERENT SPACE-CHARGE FORCES. Moehl, D. (European Organization for Nuclear Research, Geneva (Switzerland)).

The influence of longitudinal on transverse motion via incoherent space-charge forces might dictate a low number of synchrotron oscillations per revolution (say $Q_s < 0.15$) in high intensity low and medium energy ($E < 1-10$ GeV) machines. (auth)

32312 (CEAL–2000, pp A1-7) ADJUSTMENT OF ACCELERATION CONDITIONS AND BEAM PARAMETERS OF I-2 LINEAR ACCELERATOR. Batalin, V. A.; Kapchinskii, I. M.; Lazarev, N. V.; Plotnikov, V. K.; Poliakov, B. I. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki. Akademiya Nauk SSSR, Moscow. Radiotekhnicheskii Institut).

The 25-MeV high current proton strong-focusing linear accelerator to be used as a new injector for 7-GeV proton synchrotron was put into operation in November, 1966. The process of starting and increasing the beam current as well as the beam parameters and conditions of operation of the accelerator are described. It is reported that the beam current was raised up to 135 mA after 3 months adjusting works. (auth)

32313 (CEAL–2000, pp A8-16) NEW 20-MeV SATURNE INJECTOR STUDIES ON ION SOURCES AND PARTICLES BUNCHING. Bernard, P.; Bex, L.; J. Faure, J.; (and others) ([Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires]).

Reported are results from preliminary tests related to the construction of the new 20 MeV Saturne injector. In order to achieve a Pierce like extraction as good as possible a study was made in order to obtain a plasma density as uniform as possible at the exit of the expansion cup: the most sensitive parameters being the magnetic field in the expansion cup and the surface condition inside the cup. Last results for a 600 μs duration, 100 mA beam are indicated. A study of particle bunching was also made. Experimental results are given on the influence of intensity on a 350-keV proton beam bunching. (auth)

32314 (CEAL–2000, pp A17-18) ACCELERATING-FIELD QUADRUPOLE FOCUSING IN HIGH-CURRENT LINACS. Bondarev, B. I.; Vlasov, A. D. (Akademiya Nauk SSSR, Moscow. Radiotekhnicheskii Institut).

The beam focusing method using accelerating gaps of the quadrupole configuration in drift-tube accelerators as first proposed by V. V. Vladimirsky required a high injection energy. V. A. Teplyakov has found a way to lower this energy by providing an accelerating period with two accelerating gaps of different focusing properties rather than with one accelerating gap. The problem of the possible beam current which could be achieved with the accelerating field quadrupole focusing is discussed. Focusing conditions are found to place no extra limitation on the beam current. However, because of a lower electric strength of quadrupole gaps and one gap replaced by two the highest available current defined by phase oscillations decreases. It has been shown that to maintain the required field amplitude along the accelerating structure, the spacing between two successive gaps as well as the quadrupole lens power must be progressively lowered. After the particle has acquired a sufficient energy the second gap in a period becomes unnecessary. The required lens power and gap-to-gap spacing variations have been approximately calculated for the 0.75 to 12-MeV input part of an accelerator. (auth)

32315 (CEAL–2000, pp A19-29) GENERAL THEORY OF MULTISTEM DRIFT TUBE STRUCTURES PROPOSED FOR PROTON LINACS. Dome, G.; White, I. (European Organization for Nuclear Research, Geneva (Switzerland)).

In order to decrease detuning and beam loading effects in a standing-wave linac, mode spacing near the operating mode should be as large as possible. From this point of view, a conventional Alvarez structure can be improved by using a suitable configuration of several stems to support each drift-tube. Due to the (stems and drift-tube) resonances, a new passband, of the backward wave type, appears below the normal E_{01} passband. The position and width of this stem-passband are related to the configuration and the diameter of the stems. From 0.75 to 200 MeV proton energy, there exists a stem configuration combined with a practical stem diameter, which makes the 0 mode of the stem-passband merge with the E_{010} mode, thereby producing the largest possible mode spacing. The optimum stem diameter has been derived theoretically for two particular structures, cross-bar and four-stem. Extensive measurements of dispersion curves have been carried on with two scaled models of linac tanks: a 25 cells model for the energy range 0.75 – 5 MeV, and a 41 cells model for the range 10 – 30 MeV. Agreement between theory and experimental results is very satisfactory. (auth)

32316 (CEAL–2000, pp A30-1) 25-MeV PROTON LINAC. Kapchinskii, I. M.; Lazarev, N. V.; Plotnikov, V. K. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki); Kul'man, V. G.; Murin, B. P.; Nevyazhskii, I. Kh.; Polyakov, B. I.; Titov, N. K. (Akademiya Nauk SSSR, Moscow. Radiotekhnicheskii Institut).

The basic parameters, construction and the adjustment of the 24-MeV linac to be used as the second injector of 7-GeV proton synchrotron in order to increase the beam current, as well as for the investigation of some problems of higher energy and high intensity beam linacs are described. The pecularities of high frequency power supply of the cavities are also reported. The accelerator was ready to physical start-up at October, 1966. The beam current at present amounts to 130 mA. (auth)

32317 (CEAL–2000, pp A32-3) ON THE SHAPE OF FOCUSING FIELDS IN LINEAR ACCELERATORS. Koshkarev, D. G. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki).

It has been shown that the stationary equation for the self-consistent proper potential of an accelerated bunch can be solved at any density function in six-dimensional space of canonical variables if one requires the resulting potential of the focusing field to have a definite shape, for instance, a quadratic one. In this case, the frequencies of accelerated particle oscillations do not strictly depend on the amplitude. For three types of density distributions, the first terms of the potential expansion have been found. It has been shown that in these cases, external focusing fields must be considerably non-linear, the relative value of non-linearity with the increase of the particles number in the bunch tending to finite limit. (auth)

32318 (CEAL–2000, pp A-39-41) ON THE POSSIBILITY OF PRODUCTION OF LARGE PULSE CURRENTS IN LINEAR ELECTRON ACCELERATORS USING HOMOGENEOUS STRUCTURE. Levin, V. M.; Smirnov, V. L.; Fomin, L. P. (Scientific Research Inst. of Electro-Physical Apparatus, Leningrad (USSR)).

It is shown with an accelerating system using disk-loaded waveguides with radial slits in the disks that a homogeneous system with the phase shift $\pi/2$ the beam break-up effect is not observed. The absence of this effect gives the possibility of obtaining high peak currents and long pulses in a travelling wave linear accelerator with small number of sections. These currents permit obtaining the optimum power of the accelerated beam. (auth)

32319 (CEAL–2000, pp A42-5) POSSIBILITY OF PROTON ACCELERATION IN COAXIAL CAVITY EXCITED AT WAVE, TYPE H. Plotnikov, V. K. ([Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki]).

The possibility of designing an acceleration system at the wave, type H, in which, with all the advantages of the H-wave system, the shunt impedance equals or exceeds the shunt impedance of the Alvarez system at the diameters of the accelerating tubes great enough for accommodating the focusing lenses. (auth)

32320 (CEAL–2000, pp A46-9) DYNAMICS OF TRANSVERSE INSTABILITY OF A BEAM IN LINEAR ELECTRON ACCELERATOR. Voskresenskii, G. V.; Serebryakov, Yu. N. (Akademiya Nauk SSSR, Moscow. Radiotekhnicheskii Institut).

The further investigation of transverse instability of a bunched beam in a linear accelerator had been carried out within the frames of previously proposed model. Laplace transformation of an integral–differential equation for transverse deflection of charged bunches (or of an appropriate equation for amplitude values of a deflecting electric field) resulted in a solution having a closed integral form. The integral form of the solution had been evaluated by means of "method of steepest descent" and thus it became possible to receive simple and clear asymptotic expressions which describe the build-up of particle deflection. The quantitative relations between different design characteristics of an accelerator are found. The effect of accelerating electric and focusing magnetic fields on development of instability had been investigated. A preliminary examination of the problem had been accomplished taking into account the final value of group velocity in the structure. It was proved that the effect of the final group velocity may be regarded as equivalent to introducing some additional attenuation which is positive in case of $v_g > 0$ and negative when $v_g < 0$. An example of instability dynamics had been examined in a later case. (auth)

32321 (CEAL–2000, pp A50-5) SELF-FOCUSING ION LINAC. Teplyakov, V. A.; Maltsev, A. P.; Ermakov, S. M.; Stepanov, V. B.; Shembel, B. K.

A proton linear accelerator, operating at the wave length of 2m with a specific acceleration of 2.7×10^{-3}, normalized acceptance of a focusing channel not less than 10^{-6} mrad and average shunt impedance of 25 Mohm/m is discussed. Replacing magnet quadrupole lenses by focusing with an accelerating field results in a considerable change and simplification of all design. So-called H-cavity is used in this accelerator. There is a greater number of drift tubes per unit of length in this cavity. It causes the best focusing and quite high rate of accelerating. A diameter of the accelerator is 4 times less than CERN's or Serpukhov's injectors have; a supply system of focusing lenses is absent and the drift tubes are of simple metal design. Mentioned simplifications of the accelerating system allow to be optimistic when using the superconducting cavities in it. The self-focusing linac can be used not only as the injector. The main characteristics of the heavy ion linac are given. (auth)

32322 (CEAL–2000, pp A52-3) 800-MeV PROTON LINEAR ACCELERATOR. Murin, B. P.; Nevyazhskii, I. Kh.; Burshtein, E. L.; Kulman, V. G.; Andreev, V. G.; Fedotov, A. P. (Akademiya Nauk SSSR, Moscow. Radiotekhnicheskii Institut).

General design features and parameters of a proton linac to be used as an injector to a 1000-GeV cybernetic accelerator (proton synchrotron) are reported. The linac comprises two stages. The first one (of a 200 Mc/sec Alvarez structure) accelerates protons up to 200 MeV. For acceleration from 200 to 800 MeV cavities with washers operating at a TM_{02n} mode (π-mode) of a 1000 MHz frequency are used. Beam focusing is provided by magnet quadrupole lenses. Automatic transversal beam positioning system is provided. The system supplying rf power to the cavities has a block structure. Triode power amplifier is used for the first stage while second stage cavities are excited from 6-MW power klystrons. A description of a system to suppress coherent phase oscillations of the beam, which controls rf field phases in the cavities using the information acquired from the accelerated beam is given. (auth)

32323 (CEAL–2000, pp A54-5) HF-FIELD STABILIZATION IN STRONG CURRENT LINACS. Murin, B. P.; Polyakov, B. I.; Kvasha, A. I.; Mishchenko, A. B. (Akademiya Nauk SSSR, Moscow. Radiotekhnicheskii Institut).

Experimental investigation of new methods of rf accelerating fields stabilization in high-current linacs is reported. In the report the results of experimental investigation of beam loading effects upon RF amplitude and phase variations in the cavity are discussed. Electron bunches were used to simulate beam loading of the cavity. Power oscillating conditions as well as circuit parameters have been shown to influence greatly the RF field variation with beam loading. The results of experiments support the feasibility of simultaneous RF field amplitude and phase stabilization in a high current beam loaded cavity by the adjusting operating conditions of the oscillator tube only. (auth)

32324 (CEAL–2000, pp A-56-8) STATUS REPORT ON THE DESY 400 MeV ELECTRON POSITRON LINAC SYSTEM. Wiedemann, H. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany). Varian Ltd., Walton (England)).

DESY is developing a new injection system for the 6–7 GeV electron synchrotron. A 400 MeV electron–positron linac has been ordered with Varian. It consists of 12 sections which are 5.2 m long each and are fed by a 24 MW, 2998 MHz klystron. 320 mA of electrons can be accelerated up to 480 MeV. After the first five sections a positron converter is placed which, initially, will be of the Frascati-type, giving a useful positron current of about 1 mA. The DESY group is working on an improved converter design for a useful current of the order of 3 mA. The positrons can be accelerated up to 420 MeV in the subsequent seven accelerator sections. They are focussed by a 10-m-long solenoid followed by a 25-quadrupole FODO channel. The positron beam is designed for an emittance of 2 mrad · cm and an energy spread of ±0.5%. The maximum pulse length is 3 μsec; the repetition rate 50 pps. The linac has a 20A diode gun followed by a chopper cavity operating at the 499.67 mc synchrotron frequency. Buildings for the new injection system will be ready at the end of this year, and linac assembly will start in spring 1968. (auth)

32325 (CEAL–2000, pp A59-62) NONLINEAR BETATRON OSCILLATION RESONANCES IN ELECTRON SYNCHROTRON. Artemeva, Z. L.; Kulikov, O. F.; Metalnikov, Yu. N.; Moroz, E. M.; Petukhov, V. A.; Shorin, K. N. ([Akademiya Nauk SSSR, Moscow. Institut Fiziki]).

Third order nonlinear resonances ($3Q_r = 2$, $Q_z + 2Q_r = 2$) in a weak-focusing race-track are investigated. These resonances determine the Q-values and their variations during the acceleration in the 680-MeV electron synchrotron. The dependence of particle losses in crossing the resonances on various parameters, i.e., the rate of Q-variations, the particle energy, the beam intensity, and magnetic field perturbations is investigated. The Q-values shift during the acceleration is studied and the method of stabilization of the operating point is developed. Some higher resonances effects are investigated too but not in detail. (auth)

32326 (CEAL–2000, pp A63-5) SHIFTS IN BETATRON FREQUENCIES DUE TO ENERGY SPREAD, BETATRON AMPLITUDES, AND CLOSED ORBIT EXCURSIONS. Beck, R. A.; Belbeoch, R.; Gendreau, G.; Leleux, G. (Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire).

Two formulas available for any kind of machine, especially those having rapidly varying β functions are given on a very useful and simple way for numerical computation. The first concerns $\partial\nu/\partial E$ (including sextupolar components effects), the second applies to the effects of octupolar components of the main field or fringing field of quadrupoles on the ν's of particles. Numerical applications for ACO are presented. (auth)

32327 (CEAL-2000, pp A66-9) CASCADE STORAGE SYSTEM. Belovintsev, K. A.; Belyak, A. Ya.; Bessonov, E. G.; Kolomenskii, A. A.; Lebedev, A. N.; Fateev, A. P.; Cherenkov, P. A. (Akademiya Nauk SSSR, Moscow. Institut Fiziki).

The possibility of increasing the intensity of an accelerated beam and obtaining colliding electron-positron beams in a synchrotron is considered. In large synchrotrons the intensity of the accelerated beam depends, first of all, on the injection conditions. The use of a booster synchrotron as the injector of the principal synchrotron is suggested. The dimensions of the working region and the injection energy for the booster synchrotron are chosen to be rather large. A cascade system of particle storage is used. At first particles are stored in the booster synchrotron. Then, the particles are transferred to the principal synchrotron for further storage and investigation of interactions between colliding electron-positron beams. The storage process in the booster and the principal synchrotron is achieved as a result of radiation damping of phase amplitudes and betatron oscillations. (auth)

32328 (CEAL-2000, A70-5) SUPPORT SYSTEM AND ALIGNMENT OF THE MAGNETS OF THE 45-GeV SYNCHROTRON. Bronca, G.; Cartier, A.; Neyret, G.; Perot, J.; Poullain, M.; Witkowski, C.

The ways of supporting the magnet units are compared when one, two or four units are linked together. Statistical displacements of each support are introduced in a computer program which gives the resulting closed orbit. The magnets will be aligned by a step by step process. Two methods can be used. The first one is based on optical measurements of one magnet position with respect to the preceding one. The second one uses wire measurements to get the same information. After taking into account the extra number of measurements, a program computes the position of the magnets compared to the theoretical figure, and gives the closed orbit. To check the validity and select the best of these two methods, statistical errors are added to the theoretical values and the resulting closed orbit is computed for a large number of machines. (auth)

32329 (CEAL-2000, pp A76-8) HIGH-ENERGY BOOSTER FOR AN ELECTRON SYNCHROTRON. Crowley-Milling, M. C.; Merrison, A. W. (Daresbury Nuclear Physics Lab. (England)).

The recent measurements at SLAC have confirmed the high secondary particle production predicted by Drell and others, and shown that an electron synchrotron of 15 GeV or high energy would provide a very powerful experimental facility. A scheme is proposed for the addition of a large diameter ring to the electron synchrotron NINA. Electrons at 3 GeV would be transferred to the large ring and accelerated further to 15 GeV. There should be little loss at the transfer, so an average current of over a microamp at the higher energy should be obtainable. Taking into account the site conditions, and the desire to use the present experimental area initially, a magnet lattice of the FODO type, with four very long straights, has been chosen. The average radius is about 200 m, and the maximum energy could later be increased to 20 GeV without requiring excessive rf power. One of the advantages of such a scheme is the relatively low additional cost. The emittance of the electron beam at 3 GeV is small and so the magnets in the large ring can have a small aperture, limited mainly be the misalignments. The injection field is nearly 1,000 gauss, so that low field corrections are unnecessary, and the vacuum chamber requirements are not so stringent. For an initial maximum energy of 15 GeV, only a little over 1 MW peak rf power is required, and the small aperture allows a high frequency to be used, keeping down the cost of the accelerating structure. (auth)

32330 (CEAL-2000, pp A79-82) RF BEAM DYNAMICS IN THE CEA STORAGE EXPERIMENT. Dekleva, J.; Nicholls, G. L. (Cambridge Electron Accelerator, Mass.). (CEAL-1037).

An analysis of the effect on rf accelerating voltage (and power requirements) of large currents during injection, acceleration, storage, and bypass operation. The CEA will shortly have a linac capable of injecting 100 mA of current. Consideration is given to the amount of rf power required for capturing and accelerating this current. Subsequently, for storing this current and maintaining it in the bypass, much CW rf power is required. This power requirement is analyzed. (auth)

32331 (CEAL-2000, pp A83-4) LOAD STABILIZER FOR HEAVY-CURRENT ACCELERATORS. Glazov, A. A.; Kochkin, V. A.; Onischenko, L. M.; Semenov, M. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems).

In strong current accelerators and their models the beam power can be considerably higher than that of rf losses in an accelerating system. In the case of beam load disappearance serious changes are possible in the operation regime of the rf generator and the feeders supplying rf power to the accelerating electrodes. A system of automatic load stabilization up to 25-30 kW has been considered. The system was investigated in stabilizing the regime of the generator supplying the dee of the accelerator model by means of a 15 m feeder line. Water-cooled resistances served as beam load. A generator triode having dissipated power in the anode 30 kW connected by means of a coupling system to the dee was used as a load regulator. The controlling voltage proportional to the amplitude of the reflected wave was provided with a looped directed coupler to the feeder line. (auth)

32332 (CEAL-2000, pp A85-7) SYNCHRONOUS INJECTION INTO THE ZERO GRADIENT SYNCHROTRON. Klaisner, Lowell A. (Argonne National Lab., Ill.).

The overall performance of a synchrotron can be improved by synchronously injecting a prechopped beam. For a given captured beam, this scheme allows the average injector beam current to be lowered by a factor of approximately two, thus reducing injector beam loading problems. Diagnostics are also improved since the coasting beam is bunched and easier to detect. At the Zero Gradient Synchrotron (ZGS) there are two modes available for synchronous multiturn injection, the constant injection energy mode and the variable injection energy mode. In the first, the injected beam is stacked in radial betatron space while in the second it is stacked in synchrotron phase space. A fast beam chopper has been constructed to allow synchronous injection. This device electrostatically chops the preaccelerator beam at the synchrotron rf frequency prior to entry into the linear accelerator. A traveling wave deflecting structure is used to achieve the fast switching times. As an adjunct to synchronous injection, the chopper also allows any pattern of the eight ZGS bunches to be filled. For example, alternate bunches can be filled to investigate bunch-to-bunch coupling of coherent betatron motion. Synchronous injection allows improved synchrotron performance as well as providing a new tool to study interbunch phenomena. (auth)

32333 (CEAL-2000, pp A88-90) DESIGN STUDY FOR ITEP PROTON SYNCHROTRON RECONSTRUCTION. Koshkarev, D. G.; Tarasov, E. K. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki).

The reconstruction project realization will result in the maximum proton energy increasing up to 11 GeV and in the doubling of the magnetic cycle repetition frequency. The proton ejection will be simplified including long straight sections. The reconstruction includes the change of the radio-frequency system and the rearrangement of magnetic blocks. (auth)

32334 (CEAL-2000, pp A91-3) USE OF NONSINUSOIDAL SHAPED ACCELERATING VOLTAGE TO INCREASE PARTICLE CAPTURE EFFICIENCY IN ITEP PROTON SYNCHROTRON. Lebedev, P. I.; Barabash, L. Z.; Barkhudarjan, A. V.; Goldin, L. L.; Zlatov, Yu. M. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki).

The intensity of the accelerated beam in the ITEP proton synchrotron has been increased by 50-70% adding the second rf harmonics. The use of the second harmonics extends the phase oscillations separatrix and reduces the beam longitudinal density oscillations increasing the Coulomb effects. The optimal capture conditions have been achieved when the amplitude of the second harmonic is equal to half one of the original accelerating harmonics and the initial phase shift between them is about 50%. The second harmonic pulse prolongation is equal to 1 ms, i.e., to 2-3 synchrotron oscillations periods. (auth)

32335 (CEAL-2000, pp A94-6) BEAM SWITCHING SYSTEM FOR THE CEA BYPASS. Greenberger, H. J.; Law, L. A.; Paterson, J. M.

A beam switching system has been designed to switch the stored beams from the normal accelerator orbit used for injection and transition to dc operation, to the new orbit through the bypass. This step function switching action must be accomplished in a time short compared to the orbital period with minimal disturbance in the accelerator orbit. This can be achieved using a novel multiple kicker magnet system, which produces a 5 mrad. deflection in 0.1 μsec. and maintains this deflection for an unlimited time, combined with a high current density septum magnet which produces a 40 mrad. bend. This system can operate up to 4 GeV. Its design and operating characteristics will be discussed. (auth)

32336 (CEAL-2000, pp A96-7) A PROPOSED 150-GeV MIDLANDS ACCELERATOR. Riddiford, L. (Birmingham Univ. (England)).

A 150-GeV proton synchrotron has been proposed and support requested. Some economic and physics advantages of such an accelerator are indicated. An elementary design and some elementary theorems are stated. (auth)

32337 (CEAL–2000, pp A98-9) CHANGE OF SPACE-CHARGE DENSITY IN SYNCHROTRON AT TRANSVERSE FREQUENCIES APPROACHING RESONANCE VALUES. Stadnikov, A. G. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki).

Integro-differential equations for determination of space charge distribution invariants when betatron oscillations frequency approaches and crosses half-integer values have been obtained. An approximate method of solution has been developed for the case when the process of approaching the instability boundary is adiabatic. It has been shown that the space charge distribution exhibits resonance disturbances which change the width of the half-integer resonance. (auth)

32338 (CEAL–2000, pp A100-2) MAGNETIC NONLINEAR CORRECTION IN THE CYBERNETIC ACCELERATOR 1-GeV MODEL. Vasilev, A. A.; Sosenskii, N. L.; Dzergatch, A. I.; Mironov, E. S. (Akademiya Nauk SSSR, Moscow. Radiotekhnicheskii Institut).

The 1-GeV cybernetic accelerator of the Radiotechnical Institute, USSR Academy of Sciences, is provided with two systems of nonlinear field correction. The first one consists of 20 lenses to produce a field of any given combination of two-dimensional multipoles. The other comprises 13 pole-face windings also capable of producing flexible field configuration. The lenses and the windings are excited by two power amplifier systems controlled by independent signals. The structure of these nonlinear correction systems and their experimental capabilities are discussed. (auth)

32339 (CEAL–2000, pp A103-5) EXPERIMENTS ON ELECTRON COMPENSATION OF PROTON BEAM IN RING ACCELERATOR. Budker, G. I.; Dimov, G. I.; Dudnikov, V. G.; Sokolov, A. A.; Shamovskii, V. G. (Akademiya Nauk SSSR, Novosibirsk. Institut Yadernoi Fiziki).

Experimental results of influence of electron compensation of space charge on limited current in proton storage ring are presented. Charge-exchange injection is used. Compensation of energy losses in gas target is realized by means of induced electric field to avoid forced bunching which takes place at accumulation in synchrotron regime. Electrons compensating proton space charge are produced by ionization of residual gas. (auth)

32340 (CEAL–2000, pp A106-8) EFFICIENCY OF THICK INTERNAL TARGETS IN PROTON SYNCHROTRONS. Goryachev, Yu. M.; Zenkevitch, P. R.; Koshkarev, D. G.; Sokolov, L. I.; Tsukerman, I. S. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki).

The efficiency of internal targets is considered for which the proton ionization losses are not compensated by the accelerating field (thick targets). The losses result in decreasing of the effective vacuum chamber aperture, firstly, by radial orbit displacement due to the momentum magnetic field deviation and, secondly, by the betatron frequency approach to the nearest integral and half-integral resonance. The theory is developed which allows to evaluate the thick targets efficiency taking into account the multiple Coulomb scattering and ionization losses. Theoretical results are compared with experimental ones for the ITEP proton synchrotron. Thick targets efficiency is shown to be diminished by the rapid approach to resonance at high betatron frequency values. (auth)

32341 (CEAL–2000, pp A109-10) EFFECT OF RESONANT MAGNETIC FIELD DISTURBANCES ON STABILITY OF PARTICLE MOTION WITH BEAM CONTROL SYSTEM. Koshkarev, D. G.; Nikolaev, V. I. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki).

Effect of a resonant magnetic field space harmonic on the stability of particle motion in the presence of the rf beam control system has been considered. Additional limitation on the transfer coefficient of the control system as a function of the amplitude and the phase of the resonant harmonic has been found. The results obtained have been experimentally examined on the ITEP accelerator. (auth)

32342 (CEAL–2000, pp A111-14) MULTIPLE CROSSING OF HALF-INTEGRAL RESONANCE IN CIRCULAR ACCELERATORS WITH HIGH SPACE CHARGE DENSITY. Balbekov, V. I.; Shukeilo, I. A.

The matter under consideration is a gradient stopband crossing due to decreasing of a betatron frequency in circular-orbit accelerators with space charge forces. A coupling with synchrotron oscillations results in the multiple crossing of the stopband. The relation between the amplitude growth, the width of the stopband, the position of a working point and the space charge density are investigated. The amplitude increases twice in strong-focusing proton synchrotron with energy of some dozens GeV, if the stopband width is $\sim 10^{-3}$ (in number of betatron oscillations per revolution). The amplitude growth is approximately proportional to the stopband width and to the density of the space charge. It is shown qualitatively that space charge field non-linearity does not result in the increasing of amplitude. The use of local quadrupole fields is suggested to correct the gradient perturbations responsible for resonance. The correction of the stopband width can be carried out independently in radial and vertical directions according to information data of particle losses when crossing the resonance. (auth)

32343 (CEAL–2000, pp A115-16) 18-GeV PROTON SYNCHROTRON-INJECTOR TO THE 1000-GeV CYBERNETIC ACCELERATOR. Vodopyanov, F. A.; Gutner, B. M.; Elyan, V. V.; Kalinin, A. A.; Litvinov, V. N.

Presented are general characteristics of an 18-GeV proton synchrotron to be used as an injector to the 1000-GeV Cybernetic Accelerator. The magnet system of the FOFDOD type consists of hundred 4-m units spaced by 90 1.3-m short straight sections and ten 42.7-m long straight sections matched by quadrupole triplets. Magnet units are of W shape. The vacuum chamber inside the units has an elliptical cross-section of 70 by 150 mm internal dimensions. Magnet system is energized from a bank of storage capacitors discharged through the magnet windings by one-way bridge and a Γ shaped LC filter to obtain the current variation in the winding in accordance with the required low of $z = T\sin Rt$. Flat top is provided by shunting the winding by the bridge one-ways. Accelerating system consists of 168 ferrite tuned cavities with frequency range of 100 to 120 MHz and 14 hf power amplifiers with 250 kW power consumption. Provided are a fast ejection system to transform the beam into the main synchrotron within one turn (3.7 μsec) as well as a slow ejection system to the experimental hall. The energy of the beam injected into the synchrotron is 800 MeV, its current being up to 100 mA to give the maximum number of captured particles up to $5 \cdot 10^{12}$ per cycle with three-turn injection. (auth)

32344 (CEAL–2000, pp A117-19) INCREASE OF ITEP PROTON SYNCHROTRON LIMITING INTENSITY BY DEMONOCHROMATOR. Barabash, L. Z.; Goldin, L. L.; Zenkevitch, P. K.; Koshkarev, D. G.; Onosovskii, K. K.; Plyashkevitch, L. P.; Khoroshkov, V. S. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki).

The proton synchrotron demonochromator is used in ITEP to diminish Coulomb particles losses. The demonochromator increases the momentum spread of injected particles. Operation principles of demonochromator, its design and experimental results are described. The limit intensity of the synchrotron with the demonochromator is increased by 50–100%. (auth)

32345 (CEAL–2000, pp A120-4) THE RADIO-ELECTRONIC SYSTEM OF 70-GeV PROTON SYNCHROTRON. Mints, A. L.; Ivanov, Yu. S.; Kuzmin, A. A.; (and others) (Akademiya Nauk SSSR, Moscow. Radiotekhnicheskii Institut).

The main results of experimental investigation of the radio-electronic system used for synchronous acceleration and for beam parameter measurements are considered. The master-oscillator, main amplifier, and 55 resonance power accelerating stations provide 180 keV/turn energy gain in frequency range 2.5-6 Mh. The beam control system damps coherent synchrotron oscillations and stabilises beam radial position better than ±2 mm. The description and some parameters of closed orbit measuring system in 85 points along the vacuum chamber are presented. Technical data of the synchronizing system are presented. The betatron oscillations measuring systems are described. (auth)

32346 (CEAL–2000, pp A125-6) TRAVELING WAVE ACCELERATING SYSTEM OF A 1000 GeV PROTON SYNCHROTRON. Valdner, O. A.; Shalnov, A. V.; Khlestkov, V. A. (Akademiya Nauk SSSR, Moscow. Radiotekhnicheskii Institut).

In the case of high intensity beams and considerable energy gains per turn a travelling wave accelerating system is more preferable than a resonant one. In addition its application in the untuning variant permits to simplify the design and to increase the reliability of the operation of the accelerator. There are presented the results of the investigation of particle dynamics in a section considering the beam loading, ohmic attenuation, and particle phase slid with respect to the accelerating field. The requirements to the accelerating structure with the given parameters of the facility are formulated. The maximum possible efficiency is shown to be reached when the optimum structure is used. RF power required in this case is of the order of that obtained by the beam. In a proton synchrotron with an untuning travelling wave accelerating system there is a principal possibility to get over the transition energy without any phase shift by the choice of a certain structure geometry that ensures the necessary accelerating voltage amplitude change. The parameters of a 100-GeV proton accelerating system using a disc-loaded waveguide are given. (auth)

32347 (CEAL-2000, pp A127-8) THE 2.3-GeV ELECTRON SYNCHROTRON AT BONN. (Bonn Univ. (West Germany). Physikalisches Institut).

A general description of the design parameters and operation characteristics of the 2.3-GeV electron synchrotron at Bonn is presented. (B.G.D.)

32348 (CEAL-2000, pp A129-32) SOME METHODS OF BETATRON SPECTRUM MEASUREMENTS. Dzergatch, A. I.; Senatorov, G. F.; Uvarov, V. A. (Akademiya Nauk SSSR, Moscow. Radiotekhnicheskii Institut).

Methods of estimation of betatron oscillation parameters in a strong-focusing proton synchrotron which are based on an analysis of excitation and decay of center-of-mass oscillations in a bunch of particles with various betatron frequencies are investigated. It is shown that from the character of the amplitude or the phase variation of a pick-up electrode signal with the frequency of the exciting field one can deduce some information on the frequency of coherent betatron oscillations and on the betatron frequencies distribution. The calculations are compared with the betatron oscillation parameters measured at the 7-GeV proton synchrotron. (auth)

32349 (CEAL-2000, pp A133-4) AUTOMATIC MEASURING DEVICE. Gervaise, J. (European Organization for Nuclear Research, Geneva (Switzerland)).

Techniques using invar wires for length measurements in the CPS and for ground stability tests on large areas, have been improved since the construction of the CPS. A new device has been developed which permits either automatic reading on the apparatus itself, or the transmitting of readings to a converter for direct treatment of the data, in order to obtain the coordinates of the reference points, and the standard deviations. The device is described and a discussion on the accuracy of the apparatus is given. One thousand measurements of a length of 50 meters were made in the calibration bench, installed in one of the tunnels of the CPS. The standard deviation of this set of measurements is 14 microns. The measurements are very rapid, a single measurement takes about 3 minutes and all the operations can be done by a robot. (auth)

32350 (CEAL-2000, pp A135-8) ELECTRON-PROTON COLLISIONS IN STORAGE RINGS. Goldzahl, L. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires); Michaelis, E. G. (European Organization for Nuclear Research, Geneva (Switzerland)).

The possibility of using the CERN Intersecting Storage Ring System for electron-proton collisions is discussed and some technical implications of this mode of operation are considered. It is shown that by allowing 3-GeV electrons to collide with 25-GeV protons the center-of-mass energy is twice that obtainable with 40-GeV electrons striking a stationary target. The luminosity is calculated for probable values of electron and proton currents and some possible experiments are briefly discussed. (auth)

32351 (CEAL-2000, pp A148-9) MOTION OF ACCELERATED BUNCHES TAKING INTO ACCOUNT THE PROPER FIELD. Koshkarev, D. G.; Kaptchinskii, I. M. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki).

Stationary equation has been obtained for the self-consistent potential of an accelerated bunch at arbitrary potential of external field. The solution of the main equation determines the shape, charge and the value of the phase space volume of the bunch. The distribution in six-dimensional phase space has been obtained which linearized the main equation. Analytical solution of the linearized equation has been managed to obtain only in the case when the bunch is of spherical shape. In the general case, with quadratical external potential, the first approximation to the solution for the shape, charge and phase space volume of the bunch has been obtained. (auth)

32352 (CEAL-2000, pp A150-1) Nb_3-Sn COIL CONFIGURATIONS FOR ACCELERATORS, PART II. COMBINED FUNCTION ELEMENTS. Kruger, P. Gerald; Snyder, J. N. (Illinois Univ., Urbana).

Consideration also is given to combined function elements where a quadrupole field is superimposed onto a dipole field so that a FFAG field is produced. Circular and elliptical cross sections are considered with diameters (or major axis of the ellipse) up to 50 cm. A mock-up model is used to illustrate the type of construction which might be used for a suitable FFAG coil configuration. A coil configuration for a 200-GeV accelerator and one for a 1000-GeV accelerator is considered. Costs for the necessary Nb_3-Sn are estimated assuming present prices, sizes of ribbon and critical current values. (auth)

32353 (CEAL-2000, pp A152-7) MULTIPURPOSE MONITOR FOR THE BEAM IN AN ELECTRON SYNCHROTRON. Anderson, B.; Matin, S. M. (Cambridge Electron Accelerator, Mass.).

The monitor, consisting of four rf pick-up loops, measures intensity and also horizontal and vertical position of the electron beam simultaneously. A synchronous detector with AGC in video stage provides intensity-independent, linear signals. The device can be operated at any harmonic of the accelerating rf and, typically, has a sensitivity of 0.1 ma and 0.02 inches. The sensitivity is limited by the rf hybrids and the detector system. The device is a passive metallic unit housed entirely within the bellows at the end of a straight section of the synchrotron. (auth)

32354 (CEAL-2000, pp A158-9) PHASE-SPACE LIMITATIONS TO CLASHING-BEAM LUMINOSITIES. Milburn, Richard H. (Tufts Univ., Medford, Mass.).

Clashing-beam experiments are becoming of great interest in high-energy physics with the advent of storage rings capable of containing large currents of electrons, positrons, and eventually protons, and providing large available center-of-mass energies. In addition, clashing electron and laser-light beams have been shown capable of generating energetic and highly polarized gamma rays. In general, the interaction rate between two counter-moving and clashing beams is proportional to the product of the particulate fluxes, and depends in addition upon the geometry of the interaction region and the spatial and temporal distribution of particles in their respective beams. A fundamental over-riding limitation to the obtainable yields, which limitation can be written in terms of an elementary function of the phase-space occupancy of the two beams, is demonstrated. The simple mathematical expression for this limiting yield facilitates the optimization of interaction rates from practical geometries and provides a meaningful operational definition for the efficiency of the resulting system. (auth)

32355 (CEAL-2000, pp A160-2) ELECTRODYNAMICAL SEPARATOR OF HIGH-ENERGY PARTICLES. Volodin, V. D.; Zubarev, V. N.; Mukhin, S. V.; Popov, V. A.; Rikhvitskii, V. S.; Sayenko, A. S.; Semenyushkin, I. N.; Stepanyuk, V. L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy).

The characteristics of the JINR electrodynamical separator obtained from the work done at the beam of 4.95 GeV/c negative particles are reported. (auth)

32356 (CEAL-2000, pp A163-7) IMPROVEMENT POSSIBILITIES IN THE PERFORMANCE OF THE CERN INTERSECTING STORAGE RINGS. Courant, E. D.; Keil, E.; Sessler, A. M. (European Organization for Nuclear Research, Geneva (Switzerland)).

A combination of stacking in betatron and synchrotron phase space increases the luminosity and the flexibility in operation of the CERN Intersecting Storage Rings (ISR). Maximum luminosity is obtained by stacking such that $^2/_3$ of the horizontal aperture is occupied by betatron oscillations and $^1/_3$ by momentum spread. For experiments which require a smaller momentum spread, optimum luminosity is achieved by synchrotron stacking up to that limit, and by filling the remaining aperture using betatron stacking. In practice, this goal can be reached by betatron stacking (multi-turn injection) from the PS booster into the PS, and from the PS into the ISR, and by synchrotron stacking in the ISR. With an 800-MeV four-ring booster it is possible to inject two turns into the PS, and two turns into the ISR. Using realistic figures for beam emittances in the booster, for the efficiency of two-turn injection and for transfer errors, we got the following optimistic estimates for the improved ISR performance: maximum luminosity mode: stacked current I = 400 to 500 A, luminosity $L = 10^{33}$ cm^{-2} s^{-1} in each intersection region and mode where $\Delta E_{CM} = \frac{1}{2} m_\pi c^2$: stacked current I = 50 A, luminosity $L = 2 \times 10^{31}$ cm^{-2} s^{-1} in each intersection region. Beam-beam interactions, the negative mass instability, and the transverse resistivity instability, all limit the ISR performance at currents well above those quoted. The image dominated transverse coherent and incoherent limits are at about the above value. (auth)

32357 (CEAL–2000, pp A168-71) COMPARATIVE GEOMETRIC ABERRATIONS OF SYSTEMS OF QUADRUPOLE MAGNETS POSSESSING EQUIVALENT LINEAR PROPERTIES. Meads, Philip F. Jr. (Brobeck (William M.) and Associates, Berkeley, Calif.).

A numerical survey of the third-order geometric aberrations is presented for several configurations of quadrupole magnets. The systems studied are adjusted to provide a point image of a point source with given magnifications. The dependence of the aberrations upon the parameters of the quadrupole magnets for given magnifications is presented graphically. The results were obtained through the use of the IBM 7094 digital computer code 4P. (auth)

32358 (CEAL–2000, pp A172-4) THEORY OF THE TURNOVER QUADRUPLET. Regenstreif, E. (Paris Univ., Rennes (France). Faculte des Sciences).

It is well known that a transfer matrix Minus.One cannot be obtained in both planes of a quadrupole triplet. After having previously evolved a formalism for writing down explicitly the elements of the transfer matrix of an arbitrary multiplet the possibility of achieving simultaneous turn-over in both planes by means of a quadrupole quadruplet is investigated. (B.G.D.)

32359 (CERN–68-3) L'INFLUENCE DU BRUIT DE PROGRAMME HF SUR L'EFFICACITE DE STOCKAGE AU CESAR. (The Effect of HF Program Noise on the Efficiency of Storage at CESAR). Bruckner, A. (European Organization for Nuclear Research, Geneva (Switzerland)). Jan. 30, 1968. 44p. (In French). Dep.

Particle accelerators and storage rings use radiofrequency waves for acceleration. The effect of high frequency background on the particles in the accelerator was determined experimentally and theoretically. An approximate theory of the effect of the background on synchrotron oscillations of small and large amplitude was developed. Simplifications were necessary to find practicable formulas with an error of 5 to 10% on the total background effect. The experimental part confirmed the theory quantitatively and confirmed the validity of the scattering model. (J.S.R.)

32360 (CERN–68-12) SOVIET FORMALISM IN BETATRON OSCILLATION THEORY AND ITS COMPARISON WITH OTHER CONCEPTS. Fronteau, J.; Gouiran, R. (European Organization for Nuclear Research, Geneva (Switzerland)). Apr. 22, 1968. 25p. Dep.

The theory of betatron oscillations in a synchrotron is presented according to a logical development using first the classical Courant–Snyder formalism and second a Soviet formalism. It is then possible to compare the concepts and the terminology used in both cases. The Soviet formalism is based on the concept of complex Floquet function $\varphi(s)$ and of its derivative $\varphi'(s)$, as a solution of the equation of motion. The phase $\psi(s)$ of the Floquet function and the phase $\chi(s)$ of its derivative are used for the representation of motion and for the computation of the transfer matrices. A table gives the correspondence between the usual $\beta, \gamma, \alpha, \mu, \psi$ parameters and the Soviet terms $|\varphi||\varphi'|$, $|\varphi|'$, ψ, χ and μ. A similar correspondence is done for the computation of the perturbed closed orbit. (auth)

32361 (IFA-AL–1) NEUTRON GENERATING TUBES. Timus, D. (Academia R. P. R., Bucharest. Institutul de Fizica Atomica). 1967. 76p. Dep.

A brief review of the various methods used for production of neutrons is presented. Various aspects are then discussed with respect to neutron generating tubes. These are targets; accelerating gap; gas replenisher; classification, ion sources, and parameters of existing neutron generating tubes; power supplies; and applications. (B.G.D.)

32362 (INR–834/SLBAL/PL) RADIAL ACCEPTANCE OF 10 MeV PROTON LINEAR ACCELERATOR IN SWIERK. Dziura, Eugeniusz (Institute of Nuclear Research, Warsaw (Poland)). 1967. 22p. Dep.

In order to find the input data for the calculation of the optical beam matching system between the 0.5-MeV Cockcroft–Walton injector and 10-MeV proton linear accelerator in Swierk, three alternatives of focusing system arrangements have been calculated. The (0 + – – + + . . .) arrangement is shown as the only one applicable. For the chosen quadrupole field strength law and with the rigorous assumption that the magnetic lengths of the lenses are equal to their geometrical lengths the following numbers were obtained: $\cos \Theta = 0.788$ and $F = 70$ mrad mm. (auth)

32363 (JINR–P9-3787) RELYATIVISTSKII KOL'TSEVOI TSIKLOTRON S ZHESTKOI FOKUSIROVKOI. (Relativistic Ring Cyclotron with Strong Focusing). Anosov, V. N.; Vasilenko, A. T.; Vorozhtsov, S. B.; (and others) (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1968. 9p. (In Russian). Dep.

The main parameters of the electron model of the relativistic ring cyclotron with strong focusing, which was put into operation in the JINR Laboratory of Nuclear Problems, are given. The model is intended for investigation of dynamic acceleration processes as well as the effects of collective particle interaction in high-current proton accelerators with the internal beam current up to hundreds of mA. (auth)

32364 (PPAD–640-E) P.P.A. BEAM MEASUREMENT. Kirchgessner, J. L.; Kang, C. L.; Henness, J. (Princeton-Pennsylvania Accelerator, Princeton, N. J.). Apr. 11, 1968. Contract AT(30-1)-2137. 17p. (CONF-680427–2). Dep. CFSTI.

From Symposium on Beam Intensity Measurement, Warrington, Lancashire, England.

A beam monitoring system for the Princeton–Pennsylvania Accelerator is described which takes advantage of the following beam properties: (a) the beam is tightly bunched (2.5 nsec) separated by 33 nsec, because the rf remains on during the extraction process and (b) there is less than 1% frequency modulation during the 10 msec extraction time over the top of the magnet cycle. The beam monitoring system is composed of a ferrite loaded cavity tuned to 60 MHz (the second harmonic of the rf frequency) in order to minimize induced pickup from the rf system. An ionization chamber was used for obtaining fast beam position information on the extracted proton beam. The principle of operation of this chamber is discussed. (B.G.D.)

32365 (MIT–2098–422, pp 13-21) LINEAR ACCELERATOR GROUP. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science).

Linear accelerator developments at MIT are outlined. The electron scattering magnet to be used with the NBS electron linac, status of the 400-MeV linac project, polarization of fast neutrons scattered by carbon-12, and high-energy photoeffect studies are discussed. Publications are listed. (W.H.K.)

32366 (RHEL/R–149) DESIGN OF BEAM LINES WITH HIGH RESOLVING POWER. Reeve, P. A. (Rutherford High Energy Lab., Chilton (England)). Oct. 1967. 29p. Dep. UK 4s. 6d.

A systematic method of designing beam lines, which reduce the energy spread and emittance of beams from accelerators to match target requirements, is discussed. (auth)

32367 (SLAC–85) TWO-MILE ACCELERATOR PROJECT. Quarterly Status Report, July 1 - September 30, 1967. (Stanford Linear Accelerator Center, Calif.). Apr. 1968. Contracts AT-(04-3)-400; AT(04-3)-515. 61p. Dep. CFSTI.

Developments at the Stanford Linear Accelerator Center from June 1 to September 30, 1967, are reported. Topics discussed include operations summary, system and component performance, accelerator physics, klystron studies, mechanical engineering and fabrication, instrumentation and control, electronics engineering, counting electronics, spectrometer program, alignment, energy absorbers, and magnet power supplies. (W.H.K.)

32368 (SLAC-PUB–395) HIGH-PRECISION FARADAY CUP AND QUANTAMETER FOR SLAC. Yount, D. (Stanford Linear Accelerator Center, Calif.). Mar. 1968. Contract AT(04-3)-515. 35p. (CONF-680427–1). Dep. CFSTI.

From Symposium on Beam Intensity Measurement, Warrington, Lancashire, England.

Specifications and test data are given for a 20-GeV Faraday cup and quantameter. The Faraday cup has been designed to have unity efficiency for electrons or positrons to an accuracy of better than ±0.1% at energies up to 20 GeV. Recent data obtained with positrons as well as electrons and with secondary emission monitors, a calorimeter, and a toroid as well as ion chambers and the quantameter are consistent with those reported earlier indicating an absolute efficiency of (100.0 ± 0.2)% at energies up to 15 GeV. The quantameter was designed to have a gain linear in electron, positron, or photon energy to ±0.1%. In tests with the Faraday cup and other monitors using electron beams at Stanford and positron and electron beams at SLAC, the quantameter has been calibrated to ±0.3% and its linearity established to ±0.2% at energies up to 15 GeV. (auth)

32369 (SLAC-PUB–398) A PRECISION TOROIDAL CHARGE MONITOR FOR SLAC. Larsen, R. S.; Horelick, D. (Stanford Linear Accelerator Center, Calif.). Apr. 1968. Contract AT(04-3)-515. 36p. (CONF-680427–3). Dep. CFSTI.

From Symposium on Beam Intensity Measurement, Warrington, Lancashire, England.

A charge monitor system which utilizes a ferrite toroid operated in a resonant mode is described. The system is designed to monitor electron and positron beam pulses of ≤ 2 μsec duration having peak intensities of 50 μA to 50 mA, at a maximum rate of 360 pps. The digital accumulator which totalizes charge is bidirectional in order to reduce the effects of noise. For runs of 10^4 samples (~30 seconds at 360 pps), the error due to noise is ≤ 0.1 percent of reading over a 1000:1 signal range. Faraday cup comparisons for currents greater than 1 mA peak show agreement to <1 percent, with a standard deviation of <0.1 percent. The system includes a built-in calibration and test facility; toroid temperature stabilization; digital displays for total charge, charge per beam pulse, and number of beam pulses; and digital outputs to a computer. (auth)

32370 (SLAC-PUB-405) METHOD OF STABILIZING HIGH-CURRENT SECONDARY EMISSION MONITORS. Garwin, E. L.; Dean, N. (Stanford Linear Accelerator Center, Calif.). Apr. 1968. Contract AT(04-3)-515. 5p. (CONF-680427-4). Dep. CFSTI.

From Symposium on Beam Intensity Measurement, Warrington, Lancashire, England.

The problem of fabricating secondary emission monitors which are stable in electron beams with current densities in the range 1 to 40 μA/cm² is studied. The problem consists of finding a foil coating material which does not sorb CO, and silver was found to be such a material. The vacuum evaporation procedure is described, and efficiency curves for the secondary emission monitors are presented. (W.H.K.)

32371 (UCRL-17795(Add.)) SOME THOUGHTS ON STABILITY IN NONLINEAR PERIODIC FOCUSING SYSTEMS. McMillan, Edwin M. (California Univ., Berkeley. Lawrence Radiation Lab.). Mar. 29, 1968. Contract W-7405-eng-48. 3p. Dep. CFSTI.

The long-term stability of particle motions through periodic focusing structures containing lumped nonlinear elements is discussed. A group of curves invariant under the transformation: $x' = y$, $y' = -x + f(y)$, which are called double quadratic curves, is discussed. (W.H.K.)

32372 IMPORTANCE AND SHIELDING OF MUONS AROUND HIGH-ENERGY ELECTRON ACCELERATORS. Nelson, W. R. (Stanford Linear Accelerator Center, Calif.). Trans. Amer. Nucl. Soc., 11: 395-6(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32373 THE NATIONAL ACCELERATOR LABORATORY ½-TeV PROTON SYNCHROTRON: SOME CHARACTERISTICS AND RADIATION PROBLEMS. Awschalom, Miguel (National Accelerator Lab., Oak Brook, Ill.). Trans. Amer. Nucl. Soc., 11: 393-4(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32374 CALCULATION OF SEVERAL CHARACTERISTICS ASSOCIATED WITH PARTICLE BEHAVIOR FOR AN ING CONCEPT USING A REVISED VERSION OF NTC. Coleman, W. A.; Alsmiller, R. G. Jr. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 402-3(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32375 DEVELOPMENT OF SPECIAL TARGETS FOR FAST-NEUTRON SPECTRUM STUDIES. Gaerttner, E. R. (Rensselaer Polytechnic Inst., Troy, N. Y.); Greenspan, E.; Malaviya, B. K. Trans. Amer. Nucl. Soc., 11: 211(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32376 BETATRON RADIOGRAPHY. pp 262-336 of Proceedings of the 4th International Betatron Symposium, Prague, September 5-10, 1966. Rytina, K. (ed.). Prague, Institute of Plasma Physics of the Czechoslovak Academy of Sciences, 1966. (In Several Languages).

See CONF-660961.

Twelve papers on various techniques developed for betatron radiography are presented. (W.H.K.)

32377 MEDICAL APPLICATIONS OF THE BETATRONS. pp 337-71 of Proceedings of the 4th International Betatron Symposium, Prague, September 5-10, 1966. Rytina, K. (ed.). Prague, Institute of Plasma Physics of the Czechoslovak Academy of Sciences, 1966. (In Several Languages).

See CONF-660961.

Six papers are presented on medical applications of betatrons. Topics discussed include the two-component theory of radiation and its significance for radiotherapy and the effects of bremsstrahlung on tumors, lungs, and the heart. (W.H.K.)

32378 HIGH-ENERGY MUON TRANSPORT AND THE MUON BACKSTOP FOR A 200-GeV ACCELERATOR. Alsmiller, R. G. Jr. (Oak Ridge National Lab., Tenn.); Leimdorfer, M.; Barish, J. Trans. Amer. Nucl. Soc., 11: 404-5(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32379 DETERMINATION OF SHIELDING REQUIREMENTS AROUND PRESENT AND FUTURE PROTON SYNCHROTRONS BY MONTE CARLO NUCLEON-MESON CASCADE CALCULATIONS. Ranft, J. (Rutherford High Energy Lab., Chilton, Eng.). Trans. Amer. Nucl. Soc., 11: 391-2(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32380 EUROPEAN LARGE PARTICLE ACCELERATOR PROJECT. Anthoine, Roger. Bull. Belgicatom, 12: No. 4, 3-7(Nov.-Dec. 1967). (In French).

The largest particle accelerators of the world now in operation or under construction are tabulated. The operation of an accelerator is summarily described. The steps in the development of subnuclear physics in Europe, and the reasons for constructing a large accelerator are given. The principal characteristics of the 300-GeV European accelerator are outlined and the present stage of design of the accelerator is discussed. (J.S.R.)

32381 BETATRON PHYSICS AND TECHNIQUE. pp 57-261 of Proceedings of the 4th International Betatron Symposium, Prague, September 5-10, 1966. Rytina, K. (ed.). Prague, Institute of Plasma Physics of the Czechoslovak Academy of Sciences, 1966. (In Several Languages).

See CONF-660961.

Twenty-eight papers on various aspects of betatron physics and techniques are presented. Topics discussed include particle motion, electromagnet design, beam stability, vacuum engineering, beam extraction and transport, operation of a propane bubble chamber, and experimental study of the $^{19}F(\gamma,n)^{18}F$ reaction. (W.H.K.)

32382 PROGRESS REPORTS. pp 41-56 of Proceedings of the 4th International Betatron Symposium, Prague, September 5-10, 1966. Rytina, K. (ed.). Prague, Institute of Plasma Physics of the Czechoslovak Academy of Sciences, 1966. (In Several Languages).

See CONF-660961.

Research and development of the betatrons at TPI Jena, Bucharest, and Czechoslovakia are outlined. (W.H.K.)

32383 PROCEEDINGS OF THE 4th INTERNATIONAL BETATRON SYMPOSIUM, PRAGUE, SEPTEMBER 5-10, 1966. Rytina, K. (ed.). Prague, Institute of Plasma Physics of the Czechoslovak Academy of Sciences, 1966. 378p. (In several languages). (CONF-660961).

Separate abstracts were prepared for the four sections presented. (W.H.K.)

For abstracts of individual sections see: 32376, 32377, 32381, and 32382.

32384 FIAN ELECTRON CIRCULAR SYNCHROCYCLOTRON. PART I. PARAMETERS AND GENERAL DESCRIPTION. Kanunnikov, V. N.; Kolomenskii, A. A.; Lebedev, A. N.; Ovchinnikov, E. P.; Fateev, A. P.; Yablokov, B. N. (Inst. of Physics, Moscow). Prib. Tekh. Eksp., No. 5, 71-4(Sept.-Oct. 1967). (In Russian).

A 30-MeV electron radial-sector circular synchrocyclotron (CSC) capable of operating as a single- or two-beam apparatus was built in FIAN (V. N. Kanunnikov et al., Trans. Intern. Conf. on Accelerators, Dubna, 1963). The principal parameters of this strong-focusing CSC are: output energy, 30 MeV; mean final orbit radius, 160 cm; injection energy, 80 keV; mean injection-orbit radius, 120 cm; critical energy, 2.107 MeV; magnetic-field strength at 160-cm radius, 4200 oe; magnetic-field index, 16; magnet weight, 15 tons; magnet-supply power, 75 kw; orbiting frequency: 19.7 MHz at injection energy, 33.92 MHz at critical energy, 29.2 MHz at maximum energy; cycle repetition rate, up to 200 Hz; rf-oscillator power, 15 kw; maximum magnetic flux 0.13 web. The magnet is made up of 40 identical blocks 370 kg each. Two systems of acceleration—induction and rf—are used in CSC; the induction system brings the energy of electrons up to

500 keV. At present, CSC is used for investigating the transition through critical energy point, the accumulation processes, and the possibilities of improving vacuum. The CSC operates 49–50 hrs a week. The accelerated-beam intensity is 2×10^9 electrons/pulse which is equal to 4×10^{11} electrons/sec at 200 Hz. (ATD)

32385 EFFICIENCY OF USING HYDROGEN IN HIGH-CURRENT ION SOURCE WITH MAGNETIZED PLASMA EMITTER. Pleshivtsev, N. V.; Matveenko, O. G.; Vlasov, A. S. Prib. Tekh. Eksp., No. 6, 31-2(Nov.-Dec. 1967). (In Russian).

Experimental studies show that the coefficient of transformation for molecular hydrogen to protons for certain ion source conditions, could reach 80% (or 40% in cases in which proton currents are related to the number of hydrogen atoms coming into the source). (tr-auth)

32386 A 650 mA ION GUN. Karetnikov, D. V.; Matveenko, O. G.; Nizhegorodtsev, V. V. Prib. Tekh. Eksp., No. 6, 157-9 (Nov.-Dec. 1967). (In Russian).

Descriptions are given of pulsed ion source. The source produces a hydrogen ion beam with a current up to 650 mA and energy of 40 keV. The beam diameter at ~1m distance from the ion source was ~50 mm with proton content in the beam ~75%. (tr-auth)

32387 STANFORD LINEAR ACCELERATOR RESEARCH AREA (Engineering Materials). (Stanford Linear Accelerator Center, Calif.). (CAPE-1727).
7 drawings.

The research area of the Stanford Linear Accelerator, including the beam switchyard, end station B, and the 40 in. bubble chamber are described. The beam switch yard which is 1000 ft long directs the accelerator beam to the desired experimental area in two end station target buildings. End station B is the smaller of the two end stations and specializes in the analysis of secondary particles produced from inelastic interactions. The 40 in. bubble chamber installed behind end station B receives a beam of high energy x-rays produced by the electron beam for study. (For details see TID-4100.) (F.S.)

32388 PULSED GENERATOR OF 14 MeV NEUTRONS WITH A WEAK BACKGROUND BETWEEN PULSES. Al'bikov, Z. A.; Semkov, L. V. Prib. Tekh. Eksp., No. 6, 28-30(Nov.-Dec. 1967). (In Russian).

A design is given of a 14-MeV pulsed neutron generator using a deuteron beam modulated by an electric field after focusing electrodes. Such arrangement is capable of reducing about ~100 fold the neutron background in d + d interactions. (tr-auth)

32389 PRODUCTION OF LOW-ENERGY HYDROGEN ION BEAM. Khirnyi, Yu. M.; Kochemasova, L. N. Prib. Tekh. Eksp., No. 6, 33-4(Nov.-Dec. 1967). (In Russian).

Descriptions are given of a positive hydrogen ion source of 0.5 keV energy. Operation with duoplasmatron with aperture ~0.15 mm produced hydrogen current of ~1 ma with a beam diameter of ~4 mm. (tr-auth)

32390 SIMPLE APPARATUS FOR DIVERGENCE AND ROTATION OF INTENSE ION BEAM. Loshchenov, G. F.; Pleshivtsev, N. V. Prib. Tekh. Eksp., No. 6, 35-7(Nov.-Dec. 1967). (In Russian).

The stator of a three-phase electric motor of variable current with one pair of poles was used for the divergence of a 100-keV hydrogen ion beam up to an angle of 7° and rotating the beam at a rate of 3000 rotations per min. The apparatus permits one to measure the current density distribution as a function of beam cross section, to separate the ion beam from the beam of fast neutral atoms, which were obtained by means of overcharging or the dissociation of ions on a gas target, and mainly, to admit the high-power ion beam to the current collector. (tr-auth)

32391 INJECTOR OF CONTINUOUS BEAMS OF HYDROGEN IONS WITH A CURRENT OF 0.5A AND 115 keV ENERGY AND HELIUM WITH 0.15A AND 75 keV ENERGY. Pleshivtsev, N. V.; Tomashev, G. G.; Grigorovich, Yu. F.; Nizhegorodtsev, V. V.; Matveenko, O. G.; Shembel, B. K. Prib. Tekh. Eksp., No. 6, 23-7(Nov.-Dec. 1967). (In Russian).

The design of an ion injector for continuous production of focused ion beams of H^+ and He^+ with currents of 540 and 150 mA and energies of 115 and 75 keV, respectively, is discussed. At a distance of 160 cm. from the ion source the beam passed through a diaphragm of radius 5 cm. The construction of a small ion source, which uses a magnetized plasma emitter in vacuum and the magneto-electric oscillation of electrons, is outlined. The maximum current of the hydrogen ions in 4A, obtained a distance of 6 to 8 cm. from the emitter with a potential of 8 kV on the selecting electrode. The ion current density achieved in discharges using a plane electrode was 30 A/cm^2 with electron current densities of 200 A/cm^2. If there are no limitations from the aspect of arc discharge, then the ion current being selected from the source is given by a $^3/_2$-power law. (tr-auth)

32392 DINAMIKA CHASTITS V LINEYNYKH REZONANSNYKH USKORITELYAKH. (Dynamics of Particles in Linear Resonance Accelerators). Kapchinskii, Il'ya Mikhailovich. Moscow, Atomizdat, 1966. 309p.

A study is made of the motion of particles in linear resonance accelerators in which the particles are accelerated by high-frequency traveling wave fields. The particle beam is separated by the field into bunches whose frequency equals the accelerating voltage frequency. From the point of view of particle dynamics, linear resonance accelerators can be divided into two types: in the first type (for heavy particles and low energy electrons) the phase velocity of the equivalent traveling wave is less than the speed of light; in the second type (for high energy electrons) it equals the speed of light. The motion of particles in the accelerating and focusing fields is coupled with the action of the inherent field of the beam and with the disordered spread of the particle thermal velocities determined by the phase volume of the beam. The theory of intense beams with consideration of both the finite phase volume and the finite current of the beam is developed. (ATD)

32393 VOLNOVODNYYE SINKHROTRONY. (Waveguide Synchrotrons). Vorob'ev, A. A. Moscow, Izdatel'stvo Atomizdat, 1966. 102p.

The problems of particle movement in waveguide synchrotrons and the electrodynamic characteristics of various slowing-down systems which could be used in waveguide synchrotrons are examined. The effect of accelerated-particle beams on performance of waveguide synchrotrons is discussed. A detailed description of the Tomsk Polytechnic Institute 10-MeV synchrotron is given. A comparison is given of accelerating systems in form of closed-bent waveguides with accelerating systems of most modern high-power synchrotrons. The possibility of using accelerating systems in the form of closed-bent waveguides and strong-current coreless electronic and cybernetic proton synchrotrons is described. Waveguide accelerating systems, particle dynamics and waveguide synchrotrons, and the 10-MeV waveguide synchrotrons of the Tomsk Polytechnic Institute are covered. (JPRS)

32394 LINEAR PROTON ACCELERATOR I-2. I. CHARACTERISTICS OF LONGITUDINAL AND TRANSVERSE PARTICLE MOTION. Kapchinskii, I. M.; Plotnikov, V. K. (Inst. of Theoretical and Experimental Physics, Moscow). Prib. Tekh. Eksp., No. 5, 12-19(Sept.-Oct. 1967). (In Russian).

The basic parameters of longitudinal and transverse particle motion in a I-2 proton linear accelerator are described. Specifications for the acceleration and focusing systems are presented. The beam characteristics at injection and extraction are discussed. Particle bunching and debunching is evaluated. (tr-auth)

32395 LINEAR 25-MeV PROTON ACCELERATOR I-2. Batalin, V. A. (Inst. of Theoretical and Experimental Physics, Moscow); Danil'tsev, E. N.; Zhdanko, A. A.; (and others). Prib. Tekh. Eksp., No. 5, 9-12(Sept.-Oct. 1967). (In Russian).

A brief description is presented of a 25-MeV linear accelerator which is to be used as an injector for a 7-GeV proton synchrotron. (tr-auth)

32396 POSSIBILITY OF ACCELERATING PROTONS IN A COAXIAL RESONATOR EXCITED AT TE MODE. Plotnikov, V. K. (Inst. of Theoretical and Experimental Physics, Moscow). Prib. Tekh. Eksp., No. 5, 122-7(Sept.-Oct. 1967). (In Russian).

The advantages of TE-mode resonators over widely-used E_{010}-mode resonators have been examined many times in various publications (e.g., J. Bluwett, Symposium CERN, 1956). The potentialities of a linear proton accelerator whose coaxial resonator is excited at the TE_{111}-mode are estimated. The hollow central conductor is slit lengthwise along the borders of the regions where the longitudinal component of the magnetic field is maximum. Drift tubes positioned inside the central conductor are alternatively fastened to both halves of the central conductor. The theoretical analysis given in the article shows that such a proton accelerator will be shorter than the conventional accelerator (1 : 1.3); that its shunt impedance will be 1.5 times higher; and that a standing wave up to $\beta = 0.7$ will be attainable (which approximately corresponds to a proton energy of 400 MeV). (ATD)

32397 LINEAR PROTON ACCELERATOR. XI. ACCELERATION TUNE-UP AND BEAM PARAMETERS. Batalin, V. A.

(Inst. of Theoretical and Experimental Physics, Moscow); Kapchinskii, I. M.; Lazarev, N. V.; Plotnikov, V. K.; Polyakov, B. I. Prib. Tekh. Eksp., No. 5, 65-70(Sept.-Oct. 1967). (In Russian).

On November 2, 1966, for the first time, 24.6-MeV protons with a 30-mA beam were obtained from the new I-2 accelerator. The next three months were devoted to various tests and tuning-up operations which finally resulted in a 135-mA beam. Induction sensors and Faraday cylinders were used for measuring beam current. The beam-energy spectrum was examined by an analyzing magnet and by absorbing foils. The following beam tune-up operations are described in detail: (1) Matching the fore-injector beam to the focusing channel of the accelerator; (2) Production of 24.6-MeV protons; (3) Investigating the accelerator with small (5 mA) currents; (4) Running the accelerator with large (up to 135 mA) currents. Energy spectra of the output beam (105 mA with and 70 mA without the buncher) exhibit a relative impulse spread of ±3%. (ATD)

32398 LINEAR PROTON ACCELERATOR I-2. X. PUTTING IN OPERATION THE PRE-INJECTOR AND PRINCIPAL CHARACTERISTICS OF ITS BEAM. Batalin, V. A. (Inst. of Theoretical and Experimental Physics, Moscow); Kondrat'ev, B. K.; Moguchev, V. I.; Ivanov, N. F.; Solnyshkov, A. I. Prib. Tekh. Eksp., No. 5, 60-4(Sept.-Oct. 1967). (In Russian).

Improvements introduced in the accelerating system and ion source of the fore-injector are described; the original fore-injector built by the Elektrosila was described by N. F. Ivanov et al. in Elektrofizicheskaya apparatura, 1966, no. 2. By improving the optics of the focusing system, by optimizing the geometry of the accelerating system, and by increasing the proton component in the ion-source beam, an injection current of 410 mA with a mean phase current density of 750 mA/mRad · cm was attained. A cylindrical shield installed in the focusing system eliminated a troublesome aberration of the gap focusing field. The optimal accelerating-system geometry was attained by making the second accelerating electrode movable and controlling its position through the vacuum seal. A modified design of the ion source (better gasketing, Ta-cathode instead of oxide-coated) yielded a proton content in the beam of 75% or more, with a heavy-ion content of 5% or less. (ATD)

32399 LINEAR PROTON ACCELERATOR I-2. IX. DRIFT-TUBE POSITION ADJUSTMENT. Khesed, E. A. (Radiotechnical Inst., Moscow). Prib. Tekh. Eksp., No. 5, 55-9(Sept.-Oct. 1967). (In Russian).

Precision adjustments of the longitudinal and transverse position of the drift tubes are detailed. A Taylor–Hobson microtelescope was used for alignment procedures; the microtelescope was operated alternatively as an autocollimator and as a viewing tube. These results are reported: the transverse alignment achieved by the method of pendulous target has an error of $\langle \Delta r_0 \rangle$ = 0.035 mm. The longitudinal alignment carried out by the method of reference tape has an error of $\langle \Delta z/\beta\lambda \rangle$ = 0.025%. The adjustments lasted two weeks, plus a time for preparing the instruments. (ATD)

32400 LINEAR PROTON ACCELERATOR I-2. VI. THE VACUUM SYSTEM. Koloskov, V. V. (Inst. of Theoretical and Experimental Physics, Moscow); Onosovskii, K. K.; Basalaev, M. I.; Kristi, N. M.; Kuznetsov, K. V. Prib. Tekh. Eksp., No. 5, 43-7(Sept.-Oct. 1967). (In Russian).

A vacuum system with 2×10^{-6} torr residue gas pressure inside the resonator was designed for the 25 MeV proton linear accelerator. The liquid nitrogen trap feeding is given. Experiments confirmed the efficiency of the vacuum system operating under the required pressure and electrical stability in the acceleration gaps at high-frequency field gradients up to 165 kW/cm. (R.V.J.)

32401 LINEAR PROTON ACCELERATOR I-2. V. ELECTRONIC APPARATUS. Belov, A. D.; Guseva, K. I.; Kaminskii, N. K.; Murin, B. P.; Solov'ev, L. Yu. (Radiotechnical Inst., Moscow). Prib. Tekh. Eksp., No. 5, 40-3(Sept.-Oct. 1967). (In Russian).

An automatic system for the regulation and control of the parameters of the accelerating field is described. Also discussed is the timing device for various processes in the accelerator. (tr-auth)

32402 LINEAR PROTON ACCELERATOR I-2. IV. HIGH-FREQUENCY FEEDING SYSTEM. Bobylev, V. I. (Inst. of Theoretical and Experimental Physics, Moscow); Ivanov, Yu. D.; Mishchenko, A. V.; Nevyazhskii, I. Kh.; Polyakov, B. I. Prib. Tekh. Eksp., No. 5, 34-9(Sept.-Oct. 1967). (In Russian).

Descriptions are given of the high-frequency accelerator rf power system and its operation during initial connection into resonator and during the start-up. (tr-auth)

32403 LINEAR PROTON ACCELERATOR I-2. III. FOCUSING SYSTEM. Vengrov, R. M. (Inst. of Theoretical and Experimental Physics, Moscow); Veselov, M. D.; Veselova, G. V.; Danil'tsev, E. N.; Kapchinskii, I. M.; Kozodaev, A. M.; Kuibida, R. P.; Lazarev, N. V.; Plotnikov, V. K.; Strel'tsov, N. S. Prib. Tekh. Eksp., No. 5, 28-33(Sept.-Oct. 1967). (In Russian).

Construction of 190 to 150 mm drift tubes for focusing 25 MeV proton linear accelerator is described. Methods and results of magnetic measurements are discussed, and a schematic of the magnetic lens power system is included. (tr-auth)

32404 LINEAR PROTON ACCELERATOR I-2. II. HIGH-FREQUENCY ACCELERATION SYSTEM. Andreev, V. G.; Kul'man, V. G.; Kushin, V. V.; Nevyazhskii, I. Kh.; Podoinitsyn, N. S.; Titov, N. K.; Khesed, E. A.; Chistov, V. B. (Radiotechnical Inst., Moscow). Prib. Tekh. Eksp., No. 5, 19-28(Sept.-Oct. 1967). (In Russian).

A high-frequency accelerating system for 25-MeV proton linear accelerator designed with cylindrical resonators containing drift tubes is described. The data for selecting the basic parameters of the system and construction specifications are discussed. Descriptions are also given of the buncher and debuncher. (tr-auth)

32405 FIAN ELECTRON CIRCULAR SYNCHROCYCLOTRON. PART XI. PUTTING THE ACCELERATOR IN OPERATION. Kazanskii, L. N.; Kanunnikov, V. N.; Kolomenskii, A. A.; Ovchinnikov, E. P.; Papadichev, V. A.; Semenov, S. S.; Fateev, A. P.; Yablokov, B. N. (Inst. of Physics, Moscow). Prib. Tekh. Eksp., No. 5, 115-21(Sept.-Oct. 1967). (In Russian).

The procedures of putting the FIAN circular synchrocyclotron in operation are briefly described. A well-shaped adjustable-parameter beam was obtained from the injector. In the first revolution, the beam position was determined by fluorescent screens and movable shields; beam intensity was measured by the Faraday cylinder. A single-revolution injection permitted observing 5–6 beam passages on the oscilloscope screen. Self-bunching of the beam, under multirevolution-injection conditions, was observed. A Ta-target with a scintillation detector served for recording accelerated beams in further experiments. Use of induction electrodes permitted measuring beam frequency, number of particles per cycle, energy spread, particle-recapture efficiency, and beam lifetime. Frequency modulation permitted capturing betatron-accelerated particles (2×10^9 electrons per pulse) and accelerating them up to the critical energy. Three methods of transition through the critical-energy point were tested: (1) phase flipping, (2) fast turn-off–turn-on of accelerating voltage, (3) programming the rf system in such a way that its maximum frequency would exceed the critical frequency. Procedures for finer correction of the operating point are described. The frequency of betatron oscillation and the beam lifetime were measured for the purpose of determining the efficiency of pulse storage; three methods of lifetime measurement are described. (ATD)

32406 FIAN ELECTRON CIRCULAR SYNCHROCYCLOTRON. PART X. MAGNETIC MEASUREMENTS. Kanunnikov, V. N.; Papadichev, V. A.; Fateev, A. P.; Yablokov, B. N. (Inst. of Physics, Moscow). Prib. Tekh. Eksp., No. 5, 110-15(Sept.-Oct. 1967). (In Russian).

Bench tests of individual blocks of the electromagnet showed no irregular distribution of magnetic index and gradient over ±1%. After the magnet had been assembled, the field was corrected in the small radii (117 to 126 cm) range; it was also noticed that the magnetic-index curve depended on the method of magnet turn on. The final procedure of field correction (error in measurement of field constant component, 1.5%; error in measurement of harmonics, 3, 10^{-4}) is described. A system of constant monitoring of the field at small radii based on measuring the difference of magnetic potentials between upper and lower members of each magnet block was devised. The system samples the entire ring in 15 min. By adjusting the positive-to-negative-block currents, the value of f_0 was varied within ±5% (f_0 is the ratio of the constant component of the 20th harmonic). (ATD)

32407 FIAN ELECTRON CIRCULAR SYNCHROCYCLOTRON. PART IX. GEODESIC POSITIONING OF ELECTROMAGNET BLOCKS. Papadichev, V. A.; Yablokov, B. N. (Inst. of Physics, Moscow). Prib. Tekh. Eksp., No. 5, 107-10(Sept.-Oct. 1967). (In Russian).

Tolerances of about 0.1 mm and 40 angular seconds were adopted for geodesic positioning of individual blocks of the electromagnet. Mechanical devices for precise adjustment and measuring of block position are briefly described. First, the lower members of the blocks were positioned for the azimuth, radius, and altitude. Then, these lower members were fastened tightly, and the magnet was assembled for measuring purposes. After assembling, some blocks were readjusted. The magnetic measurements completed, the upper members were taken off, the vacuum chamber was mounted, and the blocks reassembled. Seven blocks required a new readjustment. Final errors in block positions are tabulated. (ATD)

32408 FIAN ELECTRON CIRCULAR SYNCHROCYCLOTRON. PART VIII. RF SYSTEM. Dmitriev, E. A.; Zalmanzon, V. B.; Kolomenskii, A. A.; Lebedev, A. N.; Ovchinnikov, E. P.; Ryzhik, Z. G.; Semenov, S. S.; Fateev, A. P. (Inst. of Physics, Moscow). Prib. Tekh. Eksp., No. 5, 103-6(Sept.-Oct. 1967). (In Russian).

The synchrocyclotron (phasotron) acceleration is the basic type of operation used in practice at FIAN. The betatron operation is used only for preliminary acceleration up to 350 keV and sometimes far passing the critical-energy regime. The preliminary betatron acceleration narrows the modulation range, raising the initial frequency from 19 to 29 MHz. Other parameters of the rf system are: frequency at critical energy, 33.5 to 34.5 MHz; initial accelerating-voltage amplitude, over 100 V; modulation rate initial, 10^4 MHz/sec and cycle-end, 3 MHz/sec; repeatability: of frequency, 1%, of amplitude, 5%, of maximum frequency, 10^{-4}; permissible rate of frequency change: near critical energy, 10^4 MHz/sec, at phase shift, 10^3 MHz/sec. A block diagram of the rf scheme of the circular synchrocyclotron is explained. An oscillogram shows the process of recapture of particles at a constant frequency and instantaneous application of accelerating voltage. (ATD)

32409 FIAN ELECTRON CIRCULAR SYNCHROCYCLOTRON. PART VII. VACUUM CHAMBER AND BEAM INDICATION APPARATUS. Dezhnev, A. K.; Kazanskii, L. N.; Kanunnikov, V. N.; (and others) (Inst. of Physics, Moscow). Prib. Tekh. Eksp., No. 5, 98-102(Sept.-Oct. 1967). (In Russian).

The 400-liter vacuum chamber of the circular synchrocyclotron is welded from 3-mm stainless-steel sheet with reinforcing ribs; the chamber has 19 internal and 26 external nipples for connecting vacuum pumps, measurements, etc. Five Ti-pumps exhaust the chamber; working vacuum is 1.5×10^{-6} torr; total inleakage, 10^{-4} lit torr/sec. Two accelerating gaps are designed for pulse and 30-MHz voltages (amplitude, about 1.5 kV) and ensure both induction and rf accelerations. The beam can be observed in its first revolutions by means of phosphor-coated screens and metal mirrors; error of beam position, 1.5 mm. A scintillation detector is used to record the accelerated beam; the detector is light-pipe-connected to a photomultiplier. Beam intensity and orbit frequency can be measured by induction electrodes; the measuring device has a uniform 0.5 to 40-MHz band, a gain of 2000, and can record intensities of 10^7 to 10^{11} particles per pulse. Betatron-oscillation frequencies are measured by a special device which amplifies the oscillations in the vertical and horizontal planes; the device consists of a two-turn coil and two flat electrodes. A coil current of 0.4 amp and an interelectrode voltage of 60 V are required to amplify a 1.5-MeV beam for 10 μsec. (ATD)

32410 FIAN ELECTRON CIRCULAR SYNCHROCYCLOTRON. PART VI. INJECTION. Gapanovich, V. G.; Kazanskii, L. N.; Papadichev, V. A.; Smirnov, O. A.; Yablokov, B. N. (Inst. of Physics, Moscow). Prib. Tekh. Eksp., No. 5, 93-8(Sept.-Oct. 1967). (In Russian).

Particle injection into the FIAN circular synchrocyclotron has some peculiarities which are due to the nonlinearity of betatron oscillations; the nonlinearity is responsible for restriction of the stability range and substantial distortion of function shape of the accelerator acceptance. Under two-beam operating conditions, the injection is possible only in defocusing blocks; under single-beam conditions, in both focusing and defocusing blocks. The injector emittance is shown in phase diagrams; plots of spread of amplitudes vs injection amplitude are also shown. A sketch of the injector construction is explained. The injector cathode is boat-shaped (18 × 2.3 × 1.3 mm), made from Ta, and operates at 1650°C. The operating efficiency of the electron gun is 75 to 80% (1 × 10 mm beam). Over 60% of the beam passes through the inflector which structurally is a sector of a cylindrical capacitor with a 3 × 25 mm aperture and a mean radius of 30 mm. The first orbit current can reach as high as 40% of the inflector-output current. The injector-supply system comprises: (a) an extraction-voltage negative-pulse generator (amplitude up to 90 kV; duration, 3 μsec); (b) two positive-pulse generators (one of them—main—having amplitudes up to 30 kV and duration 2.5 μsec). (ATD)

32411 FIAN ELECTRON CIRCULAR SYNCHROCYCLOTRON. PART IV. MAGNET-SUPPLY SYSTEM. Voronin, V. S.; Kanunnikov, V. N.; Papadichev, V. A.; Semenov, S. S. (Inst. of Physics, Moscow). Prib. Tekh. Eksp., No. 5, 86-90(Sept.-Oct. 1967). (In Russian).

The azimuth-alternating radius-ramp magnetic field, in the circular synchrocyclotron, is produced by several windings carrying different currents. Each magnet block has three distributed windings and one yoke winding. Like windings of all positive (and negative) blocks are series connected and form one circuit. Each circuit is supplied separately. Heavier (about 200 amp) current windings are supplied by 220-V 65-kW dc generators driven by one common synchronous motor (220 V, 199 kW, 1000 rpm). Other windings are fed by an induction-motor-driven 230-V 13-kW dc generator; ripple filters and current stabilizers are employed. Energizing and deenergizing the magnet obeys certain rules: (1) coordinated standardized current buildup in the windings with an error of 5×10^{-4}; (2) no spike higher than 5×10^{-4} by the end of the buildup; (3) standardized fast turnoff. The repeatability of the magnetic field with an error under 0.001 is achieved. (ATD)

32412 FIAN ELECTRON CIRCULAR SYNCHROCYCLOTRON. PART III. MAGNET. Indyukov, N. N.; Kanunnikov, V. N.; Kolomenskii, A. A.; Krasil'nikov, D. D.; Rozhdestvenskii, B. V.; Stolov, A. M.; Titov, V. A.; Fateev, A. P.; Yablokov, B. N. (Inst. of Physics, Moscow). Prib. Tekh. Eksp., No. 5, 81-6(Sept.-Oct. 1967). (In Russian).

The principal results of design and simulation studies of the synchrocyclotron magnet were published earlier (V. N. Kanunnikov, Zh. Tekhn. Fiz., 33: 592(1963)). Additional information is presented in this article. The azimuth-periodic magnetic field increases along the radius from tens to thousands of Oe, within a 45-cm wide ring; the field index and the azimuthal function are maintained with an error of a few tenths of 1%. Magnetizing ampereturns are distributed over the shaped pole pieces. Each Armco-iron block of the magnet consists of two identical members (upper and lower beams) carrying identical pole pieces and a yoke support. Within r = 150 to 160 cm, the field is shaped by the pole pieces, which ensure a constant field index at the block midline. The distributed windings are placed in 8-mm wide uniformly cut slots. An additional winding situated on the yoke serves to compensate the effect of finite permeability of iron. Preliminary bench testing of magnet blocks is briefly described. (ATD)

32413 FIAN ELECTRON CIRCULAR SYNCHROCYCLOTRON. PART II. OPERATING POINT AND TOLERABLE DEVIATION OF MAGNETIC FIELD FROM ITS RATED VALUE. Fateev, A. P. (Inst. of Physics, Moscow). Prib. Tekh. Eksp., No. 5, 75-81(Sept.-Oct. 1967). (In Russian).

The selected operating point of the FIAN circular synchrocyclotron (CSC) lies away from the ideal-field nonlinear resonances, field-azimuthal-asymmetry resonances, and linear coupling resonances. Formulas and curves for calculating the above resonances are presented. It is found that the maximum amplitude of a coupled motion is lower than that without coupling, the difference being greater the closer the operating point lies to the coupling resonance. Estimated tolerances for the nonresonance field disturbance, resonance disturbance, and instability of magnetic field are tabulated; operating under symmetrical conditions requires much closer magnetic-field tolerances. (ATD)

32414 FIAN ELECTRON CIRCULAR SYNCHROCYCLOTRON. PART V. BETATRON CORES. Kazanskii, L. N.; Kanunnikov, V. N.; Yablokov, B. N. (Inst. of Physics, Moscow). Prib. Tekh. Eksp., No. 5, 90-2(Sept.-Oct. 1967). (In Russian).

Betatron cores are designed for performing several functions in the circular synchrocyclotron: (1) fast extraction of particles from the injector and accelerating them to 0.8 to 2.5 MeV; (2) operation as an independent accelerating system up to 5 MeV; (3) accelerating the particles in experiments with dumping the beam onto a target. Each of two betatron cores has a cross-section of 750 cm^2; length of the magnetic-circuit mean line, 900 cm; 0.5 mm transformer steel is used in the cores. The particles are accelerated by the building-up flux; the falling-off flux is damped. Each core carries two windings which are excited by discharging a storage capacitor through a hydrogen thyratron. Only one winding at a time is energized. At 50 Hz, 10 kV, and synchronous operation of both cores, an acceleration up to 2.5 MeV is possible; at 12.5 Hz and larger capacitors, energies up to 5 MeV can be obtained. (ATD)

32415 LINEAR PROTON ACCELERATOR I-2. VIII. BEHAVIOR OF THE FOUNDATION. Porubai, N. I.; Danil'tsev, E. N.; Kapchinskii, I. M.; Shchelkanov, M. V. (Inst. of Theoretical and Experimental Physics, Moscow). Prib. Tekh. Eksp., No. 5, 52-5(Sept.-Oct. 1967). (In Russian).

The monolithic reinforced-concrete foundation for the I-2 accelerator is 23.5 m long, 4.75 m high and has an essentially I-beam cross-section; the foundation was built in soft ground. Initially, deformations of the foundation were measured monthly with a mean-square error of ±30 μ. A symmetrical vertical sag with a maximum about 1.3 mm in the middle was detected over a 3-year period (1961–63); there was also some horizontal deformation. Later, the deformations decreased (to 0.7 mm) and slowed down. It was also observed that the end of the foundation performs a slow seasonal vertical oscillation of about 0.5 mm. Some horizontal oscillations (stronger in winter) were also noticed (0.4 mm over 1.5 years). The above vertical deformations might cause up to 300 μ deviation in the drift-tube axis. Hence, special wedge-type compensators were provided for adjusting the position of the drift tubes on the foundation and main beams. Mechanically, a mounted drift tube is a vibrator having natural frequencies within 7 to 11.5 Hz and a Q-factor of 150 to 180. Fortunately, these frequencies did not resonate with the foundation vibrations. However, a strong 10.5-Hz vibration peak of drift tubes was caused by the operation of a ventilating machine; the peak was eliminated by providing a special damper on that machine. In addition, viscous-friction dampers were installed on all drift tubes. (ATD)

32416 LINEAR PROTON ACCELERATOR I-2. VII. LAYOUT, EQUIPMENT, AND AUXILIARY SYSTEMS. Zhdanko, A. A. (Radiotechnical Inst., Moscow); Kapalin, V. N.; Kovalev, N. V.; Koloskov, V. V.; Lazarev, N. V.; Miller, V. Ya.; Mirochnik, E. A.; Edemskii, V. I. Prib. Tekh. Eksp., No. 5, 47-52(Sept.-Oct. 1967). (In Russian).

The I-2 accelerator-injector is installed in a building adjacent to the ring-shaped magnetic room of the U-7 proton synchrotron; the floor space of the accelerator room is 42.5 × 7.4 m. The accelerator housing rests on 12 adjustable supports which ensure mechanical alignment and take up the weight uniformly. Three windows and two peepholes made in the housing permit observing various glows and discharges appearing during the accelerator operation. Pumps, control equipment, rf oscillators, and auxiliary apparatus are installed in an annex to the accelerator room. The water-cooling system of the accelerator is subdivided into groups (resonators, drift tubes, rf equipment, pumps, etc.) depending on temperature-stability and water quality requirements. Most apparatus of the accelerator are supplied from a 380/222-V ±5% line; total consumption, 300 kVA. Rf system modulators are supplied from a 6-kV line. Tube-and-thyratron heaters are supplied by a stabilized (220 V ±0.5%, 50 Hz, 85 kVA) source. (ATD)

32417 THE SPREADING OUT, UNDER THE EFFECT OF SPACE CHARGE, OF AN ELLIPTIC CROSS SECTION BEAM INITIALLY PARALLEL TO THE AXIS. Tanguy, Pierre (Univ., Rennes, France). Compt. Rend., Ser. A and B, 266: 380-2 (Feb. 12, 1968). (In French).

The problem of the spreading out under the effect of space charge of an elliptical beam initially parallel to the axis advancing in a slip space is resolved analytically. (tr-auth)

32418 THEORY OF THE INVERSION QUADRUPLET. Regenstreif, Edouard (Univ., Rennes, France). Compt. Rend., Ser. A and B, 266: 383-6(Feb. 12, 1968). (In French).

The inversion conditions of a quadruplet quadrupole are presented in an analytical form. The nature of the solutions are examined. (tr-auth)

32419 THE RADIOFREQUENCY SYSTEM OF THE I.P.C.R. 1.6m CYCLOTRON. 2. OSCILLATOR TUBE AND RESONATOR COUPLING CIRCUIT. Fujisawa, Takashi; Odera, Masatoshi (Inst. of Physical and Chemical Research, Tokyo). Rika Gaku Kenkyusho Hokoku, 44: 2-7(Jan. 1968). (In Japanese).

The oscillator of I.P.C.R. 1.6m cyclotron was required to be used over a wide frequency range from 6 to 14 MHz and to have a maximum output power of 150 kW. To meet with these requirements the type of circuit and the values of constants were chosen adequately. In particular, the methods of coupling between the power tube and the resonator are discussed and the best working condition for the tube is determined. Graphs of constants are given as function of frequency to facilitate operation. Mechanical structures designed to realize the results of calculation are presented. (auth) (NSA of Japan)

32420 A RADIATION MONITORING SYSTEM OF TOHOKU UNIVERSITY ELECTRON LINAC. Iwai, Masaru (Mitsubishi Electric Corp., Japan). Mitsubishi Denki Lab. Rep., 42: 614-19(Apr. 1968). (In Japanese).

Radiation monitors are described for use with an electron linac installed in the Nuclear Science Laboratory of Tohoku University. The linac referred to is rated at 100 MeV (300 MeV at the maximum) and is the largest installation in this country. There are many kinds of radiation emitted by this unit. In the monitoring system mentioned, thirteen detecting points of in site and indoor area monitors and water monitors are matched through sequential scanning on a panel assigned for in a control room, thus remote indications, alarms and control being dispatched to any desired places. (auth) (NSA of Japan)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 32234, 32361, 32374, 32375, 32479, 32562, 32575, 32587, 32588, 32707, and 33091.

32421 (AAEC/TM–429) AN IBM 360 VERSION OF THE NEUTRON DIFFUSION CODE CRAM. McGregor, B.; Richards, A. G.; Wood, R. G. J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Feb. 1968. 11p. Dep.

The AAEC 360 CRAM program, written in FORTRAN IV and ASSEMBLER, is designed to run under the 360 Operating System on a 256K model 50. The program can readily be changed to take advantage of additional storage that may be available on other 360 configurations. The code includes standard output routines as well as providing the user with the facility of including his own FORTRAN coded output routines. The code package includes sets of test problems for both one- and two-dimensional geometries. (auth)

32422 (CCDN-NW–7) NEWSLETTER NO. 7. (ENEA Neutron Data Compilation Centre, Gif-sur-Yvette (France)). Mar. 1968. 73p. Dep.

A listing of the neutron cross-section evaluations that were available from CCDN in March, 1968, is presented. (D.C.W.)

32423 (CONF-670969–1) PARAMAGNETIC SCATTERING OF NEUTRONS BY TRIVALENT RARE-EARTH IONS IN AN OCTAHEDRAL CRYSTAL FIELD. Furrer, A.; Haelg, W.; Schneider, T. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). [1967]. 11p. (SM–104/5). Dep.

From Swiss Physical Society Conference, Schaffhausen, Switzerland.

The energy distribution of neutrons scattered by trivalent rare-earth compounds has been measured at room temperature. The paramagnetic lines, corresponding to transitions within the ground-state multiplet of the rare-earth ion split by the octahedral crystal field, are superposed on the nuclear parts of the energy distribution. Experimental conditions and computational methods are described to determine the position and shape of the paramagnetic lines. The resulting values of the crystal field splitting and the paramagnetic line-width are discussed. (auth)

32424 (DASA–1892-3) WEAPONS RADIATION SHIELDING HANDBOOK. CHAPTER 3. METHODS FOR CALCULATING NEUTRON AND GAMMA-RAY ATTENUATION. Stevens, Paul N.; Trubey, David K. (Oak Ridge National Lab., Tenn.). Mar. 1968. 122p. Dep. CFSTI.

Methods for solving neutron and gamma-ray shielding problems are outlined. The general Boltzmann transport equation, the spherical harmonics method, the discrete ordinates S_n method, the moments method, the Monte Carlo method, kernel techniques, diffusion theory, and the invariant imbedding approach are discussed, together with a method that involves the combination of a removal kernel with diffusion theory and the application of kernel techniques to secondary gamma-ray dose calculations. Digital computer programs that solve the models by the various techniques are summarized in an appendix. 136 references. (D.C.W.)

32425 (GA–8307) GAUGE: A TWO-DIMENSIONAL FEW GROUP NEUTRON DIFFUSION-DEPLETION PROGRAM FOR A UNIFORM TRIANGULAR MESH. Wagner, M. R. (Gulf General Atomic, Inc., San Diego, Calif.). Mar. 15, 1968. Contract AT(04-3)-167. 122p. Dep. CFSTI.

A two-dimensional few-group neutron diffusion-depletion code that can be used to calculate complete burnup histories for large thermal reactors with a hexagonal core configuration is described. The program is written in FORTRAN IV for a computer with 65K memory capacity; it has been used primarily on a UNIVAC 1108 computer under the EXEC-II operating system. A block inversion technique is used to solve the neutron diffusion equations. (D.C.W.)

32426 (GA–8556) DSZ AND PREDSZ: FORTRAN IV CODES FOR COMPUTING SLOWING DOWN SOURCES. Neill, J. M. (Gulf General Atomic, Inc., San Diego, Calif.). Mar. 25, 1968. Contract AT(04-3)-167. 16p. Dep. CFSTI.

The mathematical formulation of the revised DSZ program, which computes energy- and position-dependent slowing-down sources, is outlined. The revised code eliminates the previous overestimate of the contribution to the source terms in the lowest energy group possible for each nuclide, and a more accurate treatment for hydrogen is also included. The PREDSZ code, which computes a smoothed indium foil activity and the gradient of the activity from the measured distribution of foil activities, is also briefly discussed. (D.C.W.)

32427 (IN–1109) PMC: A GENERAL PURPOSE THREE-DIMENSIONAL MONTE CARLO CODE FOR THE IBM 7040 COMPUTER. Grimesey, R. A.; Berner, C. W.; Tong, S. (Idaho Nuclear Corp., Idaho Falls). Apr. 1968. Contract AT(10-1)-1230. 114p. Dep. CFSTI.

A three-dimensional Monte Carlo program, PMC, written in the MAP language for the IBM-7040 computer, is described. Output includes the scalar neutron flux integrals and reaction rates for resonant isotopes for an arbitrary energy group structure containing a minimum of approximations. The code is especially applicable to complex geometrical situations and areas where diffusion theory will be reliable. A statistical confidence is assigned to the results. Two versions of the program are described: a "nonresonant" version in which all cross sections are supplied in the input, and a "resonant" version in which resonant cross sections are computed directly. Simplified flow diagrams and sample problems showing the use of each version are given. (auth)

32428 (KAPL-M–6728) RAUMZEIT: A PROGRAM TO SOLVE COUPLED TIME-DEPENDENT NEUTRON DIFFUSION EQUATIONS IN ONE SPACE DIMENSION. Adams, Cyrus H.; Stacey, Weston M. Jr. (Knolls Atomic Power Lab., Schenectady, N. Y.). July 31, 1967. Contract W-31-109-Eng-52. 47p. Dep. CFSTI.

The computer program RAUM, which solves systems of static, one-dimensional diffusion-type equations, has been modified to solve transient problems by either of two methods, the time-integrated technique or a difference approximation. The original capabilities of the program remain intact, but now a static (eigenvalue) solution may be followed by a time-dependent calculation which uses initial conditions derived from the static problem. The modified code, RAUMZEIT, solves systems of up to six time-dependent diffusion-type partial differential equations in slab, spherical, and cylindrical geometries with as many as six delayed neutron precursor groups. Parameters appearing in the equations may be specified as a function of time, making possible, for example, the calculation of rod motion and reactor oscillator transients starting from critical configurations. In addition to solving multigroup neutron diffusion problems, the code has some limited use in space-time flux synthesis problems and the analysis of other diffusion phenomena (e.g., heat conduction). The code has been programmed in Fortran IV for the CDC 6600 (64K memory). (auth)

32429 (KFK-tr–235) STREUUNG KALTER NEUTRONEN AN WASSER UND EINIGEN ORGANISCHEN SUBSTANZEN. (Scattering of Cold Neutrons in Water and Several Organic Substances). Golikov, V. V.; Zhukovskaya, I.; Shapiro, F. L.; Shkatula, A.; Yanik, E. Translated into German by Peter Buriks from Proc. Inelastic Scattering Neutrons, 4th, Bombay, 1964, 2: 201-20 (1965). 25p. (In German). (CONF-804–32). Dep. JCL $2.60 fs, $1.10 mf.

Data on the scattering of cold neutrons on water, ethylene glycol, acetic acid, benzene, naphthalene, and dioxane were reported. The spectra obtained were given. The results obtained from the quasi-elastic scattering model were compared with the experimental data. (J.S.R.)

32430 (KFKI–8/1968) NEUTRON SCATTERING INVESTIGATIONS OF THE DYNAMICS OF CRITICAL STATE IN IRON. Gordon, J.; Kisdi-Koszo, Eva; Pal, L.; Vizi, I. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). Apr. 8, 1968. 13p. Dep.

The inelasticity of critical scattering was investigated in iron with the use of a pulsed monochromatic neutron beam at the IBR-1 reactor in Dubna. The measurements covered the temperature range $-2.5 \times 10^{-3} \leq \tau \leq 6.5 \times 10^{-3}$ where $\tau = T/T_C - 1$ and the critical temperature was approached within $\tau < 5 \times 10^{-4}$. The slight temperature dependence of the inelasticity was confirmed for $\rho = 5.7 \times 10^{-2}$, Å^{-1}, but the observed diffusion constant was found to be temperature-independent and higher ($\mu = 16.5$) than the value ($\mu = 11$) reported earlier by other authors. (auth)

32431 (KFKI–10/1968) INVESTIGATION OF THE DYNAMICAL PROPERTIES OF LIQUID–GAS SYSTEMS BY COHERENT COLD NEUTRON SCATTERING NEAR THE CRITICAL POINT. Bata, L.; Kroo, N. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). Apr. 11, 1968. 14p. Dep.

The critical points for CO_2 were determined by small-angle scattering experiments using Be-filtered cold neutrons and a small-angle scattering spectrometer. Similar measurements were made for CS_2 using neutrons with $\lambda = 1.15$ Å and a neutron diffractometer. Inelastic scattering data were taken at different angles and temperatures using a time-of-flight spectrometer. It was found that scattering spectra measured at different angles cannot be described by a simple Lorentzian function. Large inelastic contributions were observed near the quasi-elastic spectra and were explained by the presence of sound modes considered in terms of a hydrodynamical approximation as Brillouin modes. (D.C.W.)

32432 (LA-3893) CALCULATION OF THERMAL NEUTRON DIFFUSION LENGTH AND GROUP CROSS SECTIONS: THE GLEN PROGRAM. Clendenin, W. W. (Los Alamos Scientific Lab., N. Mex.). Mar. 1, 1968. Contract W-7405-eng-36. 47p. Dep. CFSTI.

The FORTRAN-IV program GLEN has been developed to obtain thermal neutron scattering cross sections for transport calculations, and to determine the diffusion length for thermalized neutrons. Cross-section values are computed using the results of TOR for a fine mesh of initial and final energies and angles of deflection and are used to obtain the coefficients in a Legendre polynomial expansion. The total cross section, transport cross section, and similar integral parameters are obtained by numerical integration over the energy mesh. Fine mesh cross sections are used for calculation of the diffusion length, both in diffusion theory and in a P_{11} approximation. Neutron spectra are computed corresponding to an epithermal source and a buckling for thermal neutrons, or optionally a Maxwell distribution is used for the scalar flux. Flux-weighted group cross sections based on these spectra are calculated. The printed results include transfer cross sections and may be used in a few-group Legendre polynomial treatment or in transport calculations based on the S_n method. Card output is provided in the format of cross section input for S_n programs. (auth)

32433 (NAA-SR-Memo-12529) SCORE: AN AUTOMATED CROSS SECTION EVALUATION SYSTEM. Dunford, C. L.; Berland, R. F.; Creasy, R. J. (Atomics International, Canoga Park, Calif.). Jan. 15, 1968. 75p. (ENDF-106). Dep. CFSTI.

The ability to analyze and evaluate the increasing amount of new neutron cross section information is a vital part of the effort to design economic nuclear reactors. By application of computer graphics techniques, one may supply the cross section evaluator with the tools which are necessary. By permitting man-computer interaction through computer graphics, both the rapidity and quality of evaluations will be greatly increased. A brief description of a prototype system, SCORE, is presented. Methods tested during the development of this prototype evaluation system have widespread general applications as well. (auth)

32434 SPACE-ANGLE SYNTHESIS. Zwibel, H. S. (Battelle Memorial Inst., Richland, Wash.); Bowes, B. Trans. Amer. Nucl. Soc., 11: 174(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32435 CALCULATION OF NEUTRON INELASTIC SCATTERING CROSS SECTIONS. Goldsmith, Mark (Westinghouse Electric Corp., West Mifflin, Pa.). Trans. Amer. Nucl. Soc., 11: 180-1(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32436 SCATTERING KERNEL FOR DIPHENYL. Sprevak, D. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc., 11: 181-2(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32437 A SCATTERING MODEL FOR POLYPHENYLS AND THE DIFFUSION PARAMETERS OF DOWTHERM-A. Sefidvash, F. (Reactor Lab., Otaniemi, Finland). Trans. Amer. Nucl. Soc., 11: 182-3(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32438 DOPPLER BROADENING OF RESONANCES AND INELASTIC NEUTRON SCATTERING IN URANIUM CARBIDE. Lajeunesse, C. (Rensselaer Polytechnic Inst., Troy, N. Y.); Moore, W. E.; Purohit, S. N.; Yeater, M. L. Trans. Amer. Nucl. Soc., 11: 183-4(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32439 DOPPLER BROADENING AND ASYMMETRY OF P-WAVE AND MULTI-LEVEL NEUTRON RESONANCES. Shea, T.; Purohit, S. N. (Rensselaer Polytechnic Inst., Troy, N. Y.). Trans. Amer. Nucl. Soc., 11: 184(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32440 COMPARISON AT TWO METHODS OF INNER ITERATION CONVERGENCE ACCELERATION IN DISCRETE ORDINATES CODES. Eagle, W. W. Jr.; Mynatt, F. R. (Union Carbide Corp., Oak Ridge, Tenn.). Trans. Amer. Nucl. Soc., 11: 193-4 (June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32441 EFFECT OF ANISOTROPIC SCATTERING ON THE PROPAGATION OF NEUTRONS IN SHIELDS. Oezer, Odelli; Goldstein, Herbert (Columbia Univ., New York). Trans. Amer. Nucl. Soc., 11: 194-5(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32442 ANGLE-DEPENDENT SPECTRA EMERGENT FROM SLAB SHIELDS: COMPARISON OF TWO-DIMENSIONAL DISCRETE ORDINATES CALCULATIONS WITH EXPERIMENT. Mynatt, F. R. (Union Carbide Corp., Oak Ridge, Tenn.); Muckenthaler, F. J.; Stevens, P. N. Trans. Amer. Nucl. Soc., 11: 195-6(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32443 MEASUREMENT OF NEUTRON ANGULAR FLUX IN WATER. Cerbone, R. J.; Profio, A. E.; Carriveau, G. W. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc., 11: 196-7(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32444 TEMPERATURE DEPENDENCE OF EFFECTIVE CROSS SECTIONS AND AREAS UNDER RESONANCES. Canfield, E. H. (Univ. of California, Livermore). Trans. Amer. Nucl. Soc., 11: 185-6(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32445 ENERGY-DEPENDENT NEUTRON WAVE PROPAGATION THROUGH AN INTERFACE. Baldonado, O. C. (Holmes and Narver, Inc., Los Angeles); Erdmann, R. C. Trans. Amer. Nucl. Soc., 11: 187-8(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32446 JUSTIFICATION FOR CONVERGENCE OF THE EIGENFUNCTION EXPANSION METHOD OF SOLUTION TO THE NEUTRON WAVE PROBLEM. Booth, Ray S.; Swansiger, W. A. (Wright Patterson AFB, Ohio). Trans. Amer. Nucl. Soc., 11: 188-9(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32447 NEUTRON ATTENUATION IN WATER AND ALUMINUM-WATER LAMINATIONS. Coulbourn, G. I.; Williamson, T. G.; Johnson, W. R. (Univ. of Virginia, Charlottesville). Trans. Amer. Nucl. Soc., 11: 200-1(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32448 EFFECTS OF CROSS-SECTION INACCURACIES ON INTEGRAL DATA. Prezbindowski, D. L. (Battelle-Northwest, Richland, Wash.); Sandmeier, H. A. Trans. Amer. Nucl. Soc., 11: 193(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32449 DETERMINATION OF EXTRAPOLATION LENGTH IN PULSED WATER SYSTEMS. Shalev, S.; Shani, G.; Fishelson, Z.; Ronen, Y. (Technion-Israel Inst. of Tech., Haifa). Trans. Amer. Nucl. Soc., 11: 293(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32450 NEUTRON DIFFUSION PARAMETERS OF PERFLUORODIMETHYLCYCLOHEXANE USING A TWO-REGION PULSED-NEUTRON TECHNIQUE. Bisselle, C. A.; Wethington, John A. Jr. (Univ. of Florida, Gainesville). Trans. Amer. Nucl. Soc., 11: 293-4(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32451 REENTRANT HOLE PERTURBATIONS IN PULSED-NEUTRON EXPERIMENTS. McGirt, F.; Becker, M. Rensselaer Polytechnic Inst., Troy, N. Y.). Trans. Amer. Nucl. Soc., 11: 291-2(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32452 INTERMEDIATE-ENERGY FAST REACTOR SPECTRA BY TIME-OF-FLIGHT. Preskitt, C. A.; Neill, J. M.; Stevens, C. A. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc., 11: 216-17(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32453 NEW HIGH-EFFICIENCY NEUTRON SCATTERING SYSTEM. Colwell, J. F.; Miller, P. H. Jr.; Whittemore, W. L. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc., 11: 271(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32454 PULSED-SOURCE INVESTIGATION OF THE EFFECT OF CYLINDRICAL VOID CHANNELS IN A NEUTRON DIFFUSING MEDIUM. Bull, Stanley R. (Univ. of Missouri, Columbia); Connolly, Thomas J.; Sher, Rudolph. Trans. Amer. Nucl. Soc., 11: 296-7(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32455 STATISTICAL TREATMENT OF RESONANCE ABSORPTION IN THE UNRESOLVED RESONANCE REGION. Dyos, M. W. (Westinghouse Electric Corp., Madison, Pa.). Trans. Amer. Nucl. Soc., 11: 298(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32456 TRANSPORT IN TWO HALF-SPACES. McCormick, N. J. (Univ. of Washington, Seattle); Doyas, R. J. Trans. Amer. Nucl. Soc., 11: 318(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32457 A METHOD FOR ANALYZING EXPONENTIAL CORES USING A ONE-DIMENSIONAL S_N CODE. Ludewig, Hans (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc., 11: 306-7(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32458 GENERALIZED METHOD FOR MEAN EMISSION TIME CORRECTION. d'Oultremont, P.; Gozani, T.; Koppel, J. U. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc., 11: 212-13(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32459 TIME-DEPENDENT NEUTRON THERMALIZATION IN LIGHT WATER. Menzel, J. H.; Gaerttner, E. R. (Rensselaer Polytechnic Inst., Troy, N. Y.). Trans. Amer. Nucl. Soc., 11: 214-15(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32460 FINE-SPECTRAL INTERFACE EFFECTS OF RESONANCE SCATTERING UPON MULTIGROUP CROSS-SECTION AVERAGING. Meneghetti, D.; Phillips, K. E. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 205-6(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32461 NEUTRON SPECTRUM OF $^{238}PuF_4$. Herold, T. R. (E. I. duPont de Nemours and Co., Aiken, S. C.). Trans. Amer. Nucl. Soc., 11: 210(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32462 APPROXIMATE ANALYTICAL SOLUTIONS OF THE REACTOR KINETICS EQUATIONS. Hirons, Thomas Joseph. Raleigh, N. C., North Carolina State of the Univ. of North Carolina, 1966. 231p.

Thesis.

The general reactor kinetics equations are formulated, and the numerous possible approximate models and special cases of these equations are discussed. Exact solutions are obtained for some of the more basic models. These closed-form solutions illustrate the general behavior of reactor systems under various conditions. Approximate solutions are then obtained for two of the more important models of the kinetics equations. The first of these involves a step applied reactivity with linear negative temperature feedback, constant power removal, and an effective lifetime approximation that removes the delayed neutron dependence from the problem. The equations are put into dimensionless form, which reduces the number of constants in the problem to a single parameter κ. The phase plane relation between power and temperature is derived, and the curves for various values of κ are shown to be closed, indicating that the response is undamped and periodic. A logarithmic transformation of the reduced power N is then made, and an integral form is obtained for the dimensionless time τ as a function of $w = \ln N$. This integral is tabulated for serveral values of κ. Several approximate methods are then applied to this problem, and solutions are obtained for $w(\tau)$ for the cases of small and large κ. These results give an accurate representation of the power response over most of the range of κ values. The second model involves a ramp applied reactivity with no feedback and six delayed neutron groups. Solutions of this problem are obtained using three quite different methods of approach. The first of these involves a Taylor series expansion of the reduced power N about $t = 0$, and the development of a general expression of the m^{th} order zero derivative of N. A unique summation technique is then used to obtain convergence of the series for certain cases. The second method of solution utilizes an application of the inverse method to the problem of a ramp with a cutoff. The form of the solution for a step function is used to fit the ramp portion of the reactivity at certain points. The third method is an iterative technique in which the initial values of N and the precursor densities C_i are used to obtain a first approximation for N. This expression for N is used to calculate new values of N and C_i, and the iteration is continued in this manner. The results of these three methods are found to give accurate values of N for a wide range of ramp slopes and times. (Disser. Abstr.)

32463 CHARACTERIZATION OF CRITICALITY FOR ONE-DIMENSIONAL TRANSPORT PROCESSES. Brockwell, P. J.; Moyal, J. E. (Argonne National Lab., Ill.). J. Math. Anal. Appl., 22: 25-44(Apr. 1968).

The nature of criticality in multiplicative transport processes is investigated. (D.C.W.)

32464 EXISTENCE AND UNIQUENESS OF NONNEGATIVE EIGENFUNCTIONS OF THE BOLTZMANN OPERATOR. Vidav, Ivan (Univ., Ljubljana, Yugoslavia). J. Math. Anal. Appl., 22: 144-55(Apr. 1968).

The existence and uniqueness of nonnegative eigenfunctions of the Boltzmann operator of the transport equation that describes the time evolution of a given initial neutron distribution in a bounded sourceless medium are proved. (D.C.W.)

32465 ELASTIC CONTINUUM OF THE NEUTRON-WAVE EXPERIMENT IN POLYCRYSTALLINE MEDIA. Utsuro, Masahiko (Kyoto Univ.). J. Nucl. Sci. Technol. (Tokyo), 5: 196-7 (Apr. 1968).

It is shown that the assumption of isotropy of elastic scattering is not appropriate for the analysis of the elastic continuum in neutron wave experiments in polycrystalline media. (D.C.W.)

32466 NEUTRON AGE IN HYDROCARBONS. Kozhevnikov, D. A. At. Energ. (USSR), 24: 183-4(Feb. 1968). (In Russian).

The individual neutron age for a particular compound can be calculated from the following general relation: $n^2 \tau^*(E) = f(n_H/n)$. Here $\tau^*(E)$ is the particular neutron age; n_H/n is the ratio of the number of hydrogen atoms to the total number of atoms in the molecule; and n is the density of hydrogen and carbon nuclei which are determined from the formula of the compound and its density in cm^{-3}. The inelastic slowdown on carbon can be neglected. Values of $n^2\tau^*(cm^{-4})$ as a function of n_H/n are plotted for Po–Be, Pu–Be, Ra–Be, Po–B, and ^{235}U sources as well as for a monochromatic 2-MeV neutron source. The neutron ages for these sources are tabulated for a number of organic media such as graphite, hexane, cyclohexane, metaxylol, benzene, heptane, decalin, toluene, octane, diphenyl, monoisopropyl diphenyl, mineral oil, alcohol, glycerin, Dow therm, H_2O, D_2O, ^9Be, and BeO. The results are in good agreement with experimental values, where these are available. (TTT)

32467 SLOWDOWN OF NEUTRONS IN AN ABSORBING MEDIUM. Kozhevnikov, D. A. At. Energ. (USSR), 24: 185 (Feb. 1968). (In Russian).

The application of the theory of conjugate functions to the neutron transport equation leads to a relation establishing a connection between the Green functions of the transport equation for an absorbing medium and for a medium with pure scattering. The neutron distribution in a moderator having an arbitrary energy dependence of the absorption cross section from a known neutron distribution in a nonabsorbing moderator can be calculated from the above relation which is formulated in the form of an integral equation of Walter. Physically, neutron absorption is treated as the effect of "negative" sources distributed in phase space. The final equation represents a generalization of the Weinberg–Wigner–Corngold equation for a steady-state spatially inhomogeneous concentration of neutrons. (TTT)

32468 EVALUATION OF NEUTRON CROSS-SECTIONS ON THE BASES OF OPTICAL AND STATISTICAL MODELS. Garg, S. B. (Bhabha Atomic Research Centre, Trombay, India). pp 427-34 of Proceedings of the Nuclear Physics and Solid State

Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

Optical-model and Hauser-Feshbach theory were used to calculate total, elastic, and inelastic cross sections of materials such as Cd, Cr, Mo, ^{58}Ni, ^{60}Ni, and Zr which are frequently used in reactors. Good optical parameters were determined for Cr, ^{58}Ni, and ^{60}Ni in the energy range 0.1 to 4 MeV to give best fits to total cross sections; for Cd, Mo, and Zr, optical parameters were obtained in the energy range 1 to 10 MeV. (D.C.W.)

32469 THE THERMAL-NEUTRON MILNE PROBLEM AND THE ALBEDO OF A SEMI-INFINITE ABSORBING MEDIUM. I. THEORY. **Mockel, Andre (Univ. of Florida, Gainesville). Nucl. Sci. Eng., 32: 350-6(1968).**

The Milne problem for thermal neutrons is studied with an arbitrary scattering kernel, using concepts derived from the invariant imbedding method. An eigenvalue equation for the Milne leakage current is given and an expression for the flux inside the medium expressed in terms of the Milne leakage current and the reflection operator is found. Though no unique definition of the extrapolation length exists in the general case, a very simple expression for the extrapolation length of the scattering rate is given. (auth)

32470 CALCULATION OF THE RELATIVE VALUE OF DELAYED NEUTRONS. **Toshinskii, G. I.; Bulavin, P. E. At. Energ. (USSR), 23: 146-7(1967). (In Russian).**

In order to be able to compare the experimentally determined effectiveness data with theoretical values, and to carry out reactor kinetics calculations, the effective portion of the delayed neutrons, β_{eff}, must be known. In most cases $\gamma = \beta_{eff}/\beta$ is determined. When the spatial and energy distribution of neutrons in the reactor differs from that in an unreflected one-region reactor, an exact rather than an approximation formula derived from the perturbation theory must be used. This problem was examined, assuming that the delayed neutron spectrum and the yield do not depend on the energy of the neutrons causing fission, that the distribution of prompt and delayed neutrons is isotropic in that only one fissile isotope is present in the reactor. A direct method based on the iteration of the sources was developed for the calculation. According to the derived formula, γ represents the volume-average value of fission neutrons formed in one cycle from the delayed neutrons of the same cycle, and the fission neutrons with an identical spatial distribution. (TTT)

32471 AN ACTIVATION EXPERIMENT TO DETERMINE THE COEFFICIENTS IN THE LAGUERRE EXPANSION OF PERTURBED THERMAL-NEUTRON SPECTRA. **Jedruch, Jacek (Westinghouse Electric Corp., Pittsburgh). Nucl. Sci. Eng., 31: 377-87(1968).**

A method is presented for the experimental determination of Laguerre coefficients in a polynomial expansion of strongly perturbed neutron spectra. A response matrix is constructed from the associated Laguerre functions of order one and Breit–Wigner cross sections. The magnitude of the coefficients is obtained by applying this matrix to the activations induced in selected isotopes by simultaneous exposure to the spectrum. It is shown that the coefficients characterize the spectrum and can serve as a measure of concentration of the spectrum-perturbing absorber. The method is tested experimentally by applying it to four spectra in water perturbed by addition of varying amounts of CdSO$_4$. It is found that three to four Laguerre coefficients can be obtained and the spectrum reconstructed from measured activations by Dy, Eu, Lu, and Yb. (auth)

32472 ITERATIVE METHOD FOR DETERMINATION OF A MINIMAL EIGENVALUE. **Kristiansen, G. K. (Danish Atomic Energy Commission Research Establishment, Risoe). Nucl. Sci. Eng., 31: 540-54(1968).**

The convergence of a group of iterative methods for the solution of reactor criticality problems was discussed by Kristiansen (Nucl. Sci. Eng., 16: 133(1963)). The main result was that even though the methods work satisfactorily in all practical cases, examples of divergence can be constructed. It is shown that by a small modification of the method it is possible to prove convergence in a well-defined group of cases, including one-group diffusion theory. (S.F.L.)

32473 REFLECTION AND REFRACTION OF NEUTRON DIFFUSION WAVES. **Kladnik, R. (Kansas State Univ., Manhattan). Nucl. Sci. Eng., 32: 370-6(1968).**

Some optical properties of neutron diffusion waves are discussed. Expressions are given for the change in the direction of propagation of the wave components reflected and refracted at the interface between two semi-infinite media by using appropriate formulae for the refraction of the electromagnetic waves in conducting media. It was found that the phase speed of the refracted asymptotic wave depends upon the direction of propagation. This dependence is especially noticeable in graphite/light-water systems. The phase speed is practically constant in graphite/heavy-water systems. The results predict the existence of the total reflection of the asymptotic wave on the graphite/vacuum interface, providing the incidence angle is larger than ~23°. Experimental verification of the diffusion wave refraction is suggested. (auth)

32474 ANISOTROPIC NEUTRON SLOWING DOWN IN ALUMINUM–WATER MIXTURES. II. MONTE CARLO CALCULATIONS. **Palmedo, Philip F. (Brookhaven National Lab., Upton, N. Y.). Nucl. Sci. Eng., 32: 313-18(1968). (BNL–12053).**

A set of Monte Carlo calculations are reported in which the anisotropy of neutron slowing down in $Al-H_2O$ slab systems was studied. The anisotropy in the second moment from fission to In resonance energy amounted to several percent for realistic cases. Higher anisotropies characterized the higher moments. The calculated anisotropies were in satisfactory agreement with experimental values although the calculated moments tended to be somewhat lower than experiment. (auth)

32475 ANISOTROPIC NEUTRON SLOWING DOWN IN ALUMINUM–WATER MIXTURES. I. EXPERIMENTS. **Palmedo, Philip F. (Brookhaven National Lab., Upton, N. Y.). Nucl. Sci. Eng., 32: 302-12(1968). (BNL–12018).**

Measurements were made of the anisotropy of neutron slowing down in $Al-H_2O$ plate lattices. The moments of the slowing down distribution from fission to 1.46 eV were determined in the two characteristic directions at two volume ratios using the point-source, point-detector method. For the 1 : 1 case, with an Al plate thickness of 0.25 in., the ages parallel and perpendicular to the plates were 65.4 ± 0.8 and 60.8 ± 0.8 cm^2, respectively, giving an anisotropy of 1.076 ± 0.02. In the 2 : 1 ($Al:H_2O$) case, with an Al thickness of 0.50 in., the corresponding values are 100.3 ± 1.5 and 92.5 ± 1.3 cm^2, giving an anisotropy of 1.085 ± 0.02. The higher moments were characterized by higher anisotropies. (auth)

32476 RAY EFFECTS IN DISCRETE ORDINATES EQUATIONS. **Lathrop, K. D. (Gulf General Atomic Inc., San Diego, Calif. General Atomic Div., General Dynamics Corp., San Diego, Calif.). Nucl. Sci. Eng., 32: 357-69(1968).**

The nature of anomalous computational effects due to the discretization of the angular variable in transport theory discrete ordinates approximations is described and analyzed. The origin of these effects within the derivation of the S_n discrete ordinates equations is shown, and the effects are related to the nonequivalence of the general geometry discrete ordinates equations and the corresponding spherical harmonics equations. Procedures are given for the definition of two-dimensional discrete ordinates equations that are equivalent to the spherical harmonics equations. Elimination of ray effects from the two-dimensional S_2 equations by reduction to the diffusion theory equations is verified in a numerical example. Recipes for the elimination of ray effects are analyzed in the analytic solution of the infinite medium, isotropic line-source problem in the rectangular geometry, S_2 approximation. Optimum magnitudes for corrective source terms are indicated by the analysis. It is concluded that ray effects may be eliminated by modification of the discrete ordinates formulation, but that the extra computational effort may be more expensive than the alternative of increasing the order of angular quadrature and that the presence of discretization effects may serve as an indicator of the adequacy of the angular quadrature used. (auth)

32477 ADVANTAGES AND APPLICATIONS OF ^{252}Cf AS A NEUTRON SOURCE. **Reinig, W. C. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Nucl. Appl., 5: 24-5(July 1968). (DP-MS–67-117).**

The advantages of ^{252}Cf neutron sources are demonstrated by comparing the neutron yields, neutron energies, costs, gamma dose rates, and other parameters of isotopic sources. The relative merits of accelerators as neutron sources for certain applications are also summarized. Potential applications of ^{252}Cf sources are mentioned. (D.C.W.)

32478 THEORY OF MULTIPLE SCATTERING OF SLOW NEUTRONS. **Nishigori, Takeo; Yamasaki, Shuichiro; Sunakawa, Sigenobu (Osaka Univ.). Progr. Theor. Phys. (Kyoto), 39: 37-52(Jan. 1968).**

The formula for the cross section for the multiple scattering of slow neutron derived in a previous paper (Progr. Theoret. Phys., 35: 228(1966)) is improved so as to satisfy the condition of detailed balance. The cross section is expressed in terms of the time-dependent propagators of the neutron and the many-particle space-time correlation functions for the target system. The well-defined prescription for the classical approximation is presented in the last section. (auth)

Nuclear Properties and Reactions, A≤ 5

Refer also to abstracts 30788 and 32508.

32479 (BNL–50083, pp 179-91) THEORETICAL NEUTRON PRODUCTION FROM POSITIVE-ION-INDUCED REACTIONS. Halbleib, J. A. Sr.; Scott, M. R. (Sandia Corp., Albuquerque, N. Mex.).

The use of high-energy (~5 MeV) charged-particle accelerators as high-flux neutron generators was investigated. A computer program was developed and calculations of neutron current density were made for the following: (1) the reactions T(d,n)^{4}He, T(p,n)^{3}He, and D(d,n)^{3}He, (2) projectile energies from threshold to 5 MeV, (3) thick and thin cylindrical deuterium- and tritium-loaded Ti targets, (4) laboratory angles of 0 to π, and (5) nonrelativistic approximation. Results are stored on magnetic tape. Some examples in graphical form are included in the paper. (A.G.W.)

32480 CAPTURE OF THERMAL NEUTRONS BY DEUTRONS IN THE THEORY WITH THE ZERO RANGE APPROXIMATION. Moskalev, A. N. (Ioffe Inst. of Physics and Tech., Leningrad). Yadern. Fiz., 7: 544-53(Mar. 1968). (In Russian).

Within the framework of the theory with the zero-range approximation, the cross section of the capture of thermal neutrons by deuterons as well as the value of admixture of the mixed symmetry state in the tritium wave function is calculated. (auth)

32481 SEARCH FOR STATES OF ^{4}He USING ^{2}H(d,d) AND ^{2}H(d,p)^{3}H. Bacher, A. D.; Tombrello, T. A. (California Inst. of Tech., Pasadena). Nucl. Phys., A113: 557-60(1968).

The reactions ^{2}H(d, d)^{2}H and ^{2}H(d, p)^{3}H were studied for bombarding energies between 3 and 11 MeV. This range of energy corresponds to the region in the compound nucleus ^{4}He between excitation energies of 25.3 and 29.3 MeV. The yield curves obtained are smoothly varying, and there is no indication of a resonance with an appreciable deuteron partial width. (auth)

32482 BINDING ENERGIES AND CHARGE RADII OF ^{3}H AND ^{3}He. Jaffe, A. I.; Reiner, A. S. (Weizmann Inst. of Science, Rehovoth, Israel). Phys. Lett., 26B: 719-20(May 13, 1968).

Using separable two body potentials of the Puff type not only for n–n and n–p but also for the p–p interaction, the Faddeev equations were solved exactly in order to compute binding energies and rms charge radii for A = 3 nuclei. The agreement with experiment is reasonable, but indicates that the Coulomb interaction in v_{pp} was incorporated only in part. (auth)

32483 NUCLEAR SPIN FILTER. McKibben, Joseph L.; Lawrence, George P.; Ohlsen, Gerald G. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. Lett., 20: 1180-2(May 20, 1968).

A "spin filter" for selecting metastable hydrogen, deuterium, or tritium atoms with a given nuclear spin magnetic quantum number (m_I) was built and tested. With the device installed in the Los Alamos "Lamb-shift" polarized-ion source, a deuterium negative-ion beam with ~55% spin-state purity for m_I = 1, 0, or −1 was obtained. An improved magnetic field homogeneity in the apparatus is expected to increase the purity to ~75%. (auth)

32484 INTERACTION OF 14.1-MeV NEUTRONS WITH TRITONS. Kootsey, J. Mailen (Brown Univ., Providence). Nucl. Phys., A113: 65-74(1968).

A thin tritium target was bombarded by 14.1-MeV neutrons and the outgoing protons, deuterons and tritons were studied with a specially constructed proportional counter-scintillator telescope. The angular distribution for elastic scattering was obtained for neutron angles from 55 to 180° in the cm system. A previous calculation assuming a Serber interaction was shown to give a good fit to this angular distribution. Deuterons from the breakup reaction ^{3}H(n,d)2n were detected at $\theta_{lab} = 0°$, but no breakup protons were observed. (auth)

32485 PHOTODISINTEGRATION OF HELIUM WITH VELOCITY-DEPENDENT POTENTIALS. Srivastava, B. K. (Indian Inst. of Tech., Kharagpur); Jain, S. C. pp 52-8 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

The integrated and bremsstrahlung-weighted photodisintegration cross sections for ^{4}He are calculated using the sum rules of Levinger and Bethe, as extended by Rustgi and Levinger, and the results of a variational calculation of the binding energy of the alpha particle. An effective two-body potential that is the average of potentials in ^{1}S and ^{3}S states is used. (D.C.W.)

32486 PHOTODISINTEGRATION OF DEUTERON. Mukherjee, Shankar; Mukherjee, Reba (Banaras Hindu Univ., India). pp 60-3 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

The electric dipole bremsstrahlung-weighted cross section and the integrated cross section for deuterium were calculated using a phenomenological nucleon–nucleon potential (Phys. Rev., 126: 881(1962)) and a corresponding analytical deuteron wave function that was recently proposed by Kottler and Kowalski (Nucl. Phys., 53: 334(1964)). The contribution of the one-pion-exchange potential to the integrated cross section was calculated. (D.C.W.)

32487 ALPHA–ALPHA INTERACTION POTENTIAL. Shanta, Rajagopal (Saha Inst. of Nuclear Physics, Calcutta). pp 106-10 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

An attempt is made to fit the phase-shift data for alpha-alpha scattering up to cms energies ≤ 12 MeV by a phenomenological α-α interaction potential. Following the discussions of the results obtained by Van Der Spuy and Pienaar, a potential with a strongly l-dependent repulsive core and an outside l-independent attractive region is considered in fitting the phase shifts. The repulsive core radius is smaller for higher l. With a suitable choice of the necessary parameters, this potential is seen to give reasonable results in the energy region considered. (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 32365, 32381, 32494, 32498, 32529, 32554, 32725, and 32729.

32488 THE REACTION (^{3}He,α) ON LIGHT NUCLEI. Artemov, K. P.; Goldberg, V. Z.; Rudakov, V. P.; Serikov, I. N. Yadern. Fiz., 7: 500-14(Mar. 1968). (In Russian).

Differential cross sections of the reaction (^{3}He, α) on ^{9}Be at $E_{^3He}$ = 27 MeV, on ^{12}C and ^{13}C at $E_{^3He}$ = 19, 27, and 37 MeV for a large number of levels in the wide region of finite nuclei excitation energy are measured. The data obtained are analyzed together with the results of the previously published measurements of the reactions (^{3}He,α) on ^{14}N and ^{16}O. In all the cases investigated, only those states of finite nuclei are excited the existence of which is described by the simple shell model and which must be excited as a result of the pickup of neutron from the target nucleus. The differential cross sections measured are compared with the calculation made on the basis of the distorted wave method assuming the pickup mechanism. In the most cases there is a sufficient agreement between the experimental and theoretical angular distributions in the angle interval from 10 up to 60 to 80°. Spectroscopic factors found are in good agreement with those obtained from the analysis of the reaction (p,d). (auth)

32489 MEASUREMENTS OF MASSES OF CHARGE-ONE PARTICLES EMITTED AT ABSORPTION OF π^--MESONS WITH ENERGY 150 MeV BY ^{12}C NUCLEI. Vaisenberg, A. O.; Kolganova, E. D.; Rabin, N. V. Yadern. Fiz., 7: 518-20(Mar. 1968). (In Russian).

The mass distribution was investigated for the secondary particles produced in the 150-MeV π^--meson capture by carbon nuclei. The fraction of secondary particles heavier than protons is shown to be no more than 10%. (auth)

32490 π MESON ABSORPTION ON ^{12}C INVOLVING ^{8}Li PRODUCTION. Zelenskaya, N. S.; El-Nagar, N.; Yarba, V. A. (Inst. of Nuclear Physics, Moscow). Yadern. Fiz., 7: 515-17(Mar. 1968). (In Russian).

In the framework of the direct mechanism of π-meson absorption, the process of π-meson absorption on ^{12}C involving ^{8}Li production is analyzed. The spectra of finite particles and the angular correlation of neutron and ^{3}He are calculated. The results obtained are compared with the experimental data. (auth)

32491 PHOTODISINTEGRATION OF CARBON: REACTIONS WITH EMISSION OF SEVERAL PARTICLES. Taran, G. G. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz., 7: 478-92 (Mar. 1968). (In Russian).

Effective total cross sections and some differential cross sections of the (γ,pn), (γ,pnα), (γ,pα), (γ,nα), (γ,pt), and (γ,n^{3}He) reactions are measured by means of the Wilson chamber at the maximal bremsstrahlung energy 170 MeV. Possible mechanisms of the reactions are discussed. (auth)

32492 ON THE PHOTODISINTEGRATION OF ^{6}Li. Aurdal, A.; Skavlem, S. (Univ. of Bergen). Phys. Norv., 2: 295-302(1967).

Assuming an $\alpha + p + n$ model for the nucleus, with no mutual interaction between the valence nucleons, cross sections for the reactions ^{6}Li(γ,n)^{5}Li and ^{6}Li(γ,p)^{5}He have been calculated. Using alternatively harmonic oscillator and spherical well wave functions as initial states, together with plane-wave final states, the cross sections are evaluated in electric dipole approximation. The alpha-particle core is assumed to remain inert throughout the energy range of interest, i.e., from threshold up to some 20 to 25 MeV gamma energy. (auth) (NORWAY)

32493 EFFECTS OF THE DEGENERACY ON THE BETHE-GOLDSTONE-TYPE EQUATION FOR ^{18}O. Suekane, Shota (Osaka City Univ.). Progr. Theor. Phys. (Kyoto), 39: 662-75 (Mar. 1968).

By properly taking the degeneracy of the ground state of a nonperturbed system into account, the equation of relative motion is separated from the Bethe-Goldstone-type equation for two extra neutrons of ^{18}O; the equation then depends on the eigenvalue of the two-neutron system. These equations are solved self-consistently and numerically using a free nucleon-nucleon potential. For this purpose, a formula for a hard core spike is derived, considering two nucleons are in a common harmonic oscillator potential. The equation of relative motion has an inhomogeneous term which depends on the matrix element of the free nucleon-nucleon potential, as a result of the effect of the degeneracy. The equation of the relative motion is correctly solved for the singlet s-state only for simplicity. The dependence of the matrix elements of the free nucleon-nucleon potential on two-particle state is negligible but the absolute values of the matrix elements are reduced appreciably. The degeneracy increases the repulsive effect of the hard core and this effect reduces the absolute values of the matrix elements. As a result of this reduction, the binding energies of the spin-0 states are reduced very much, especially for the ground state; and agreement between the calculated level scheme and the experimental level scheme is not good, although the Pauli principle is treated approximately and the core excitation is neglected in this lowest order calculation. (auth)

32494 GAMMA RAYS FROM BOMBARDMENT OF LIGHT AND INTERMEDIATE WEIGHT NUCLEI BY 16- TO 160-MeV PROTONS AND 59-MeV ALPHA PARTICLES. Zobel, W.; Maienschein, F. C.; Todd, J. H.; Chapman, G. T. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. Nucl. Sci. Eng., 32: 392-406(1968). (ORNL-P-3580).

Determining the contribution of secondary gamma rays to the radiation dose produced by charged particles in space requires a knowledge of the cross sections for gamma-ray production by protons and alpha particles. The only data of this type that have been available have been for ~145-MeV protons. In the experiment reported here, gamma-ray spectral measurements were made for protons of 16, 33, 56, and 160 MeV and alpha particles of 59 MeV incident on targets of low- and medium-Z materials. Absolute spectra were obtained, generally in the backward direction, with coincidence (pair) or anticoincidence (total-absorption) scintillation spectrometers. The analysis method used to correct for the imperfect spectrometer response yielded quantitative error estimates for the resultant spectra. A few measurements were made in the forward direction or at 90° to distinguish deviations from isotropy which were marked only for 16-MeV protons incident on a carbon target. From the spectra, cross sections were obtained for the production of specific gamma rays. Tables of these results include the probable nuclear reactions which produced the gamma rays. The production cross sections are plotted vs the average proton energy in the target for individual gamma rays for C and O. For each element, these individual production cross sections are added and the sums, which decrease with increasing proton energy, are compared with the total nonelastic cross sections predicted on the basis of intranuclear cascade calculations. The reasonably smooth variations of the total cross sections for gamma-ray production with atomic number are also shown. The proton inelastic scattering cross sections for specific levels correspond within error to 14-MeV neutron scattering data. (auth)

32495 TENSOR POLARIZATION OF DEUTERONS FROM ^{12}C-d ELASTIC SCATTERING. Cords, H.; Din, G. U.; Ivanovich, M.; Robson, B. A. (Australian National Univ., Canberra). Nucl. Phys., A113: 608-16(1968).

The spin tensor moments $\langle T_{20} \rangle$, $\langle T_{21} \rangle$, and $\langle T_{22} \rangle$ of deuterons from ^{12}C-d elastic scattering were measured utilizing the ^{3}He (d, p)^{4}He reaction as an analyzer of deuteron polarization. The three deuteron polarization parameters are presented as functions of incident deuteron energy between 3.5 and 7.1 MeV at 37.5° and 45° scattering lab angles. The tensor moments are also presented as functions of scattering angle between 22.5° and 75° lab angles in steps of 7.5° at 5.25, 6.10, and 7.05 MeV deuteron incident energies. An optical-model analysis which includes tensor terms in the deuteron potential was performed. (auth)

32496 THE L_I/K ORBITAL ELECTRON CAPTURE RATIO OF LOW-Z ELEMENTS. Winter, Georg (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Nucl. Phys., A113: 617-24 (1968).

The L_I/K orbital electron capture ratio was calculated for allowed transitions using analytical Hartree-Fock wave functions and taking account of relativistic corrections. (auth)

32497 ^{6}Li(p,2p)^{5}He REACTION AND ALPHA-DEUTERON CLUSTER MODEL FOR ^{6}Li. Saito, Sakae; Hiura, Jun; Tanaka, Hajime (Hokkaido Univ., Sapporo). Progr. Theor. Phys. (Kyoto), 39: 635-61(Mar. 1968).

To investigate the α-d cluster structure of ^{6}Li, the high-energy (p, 2p) reaction for the least-bound proton in ^{6}Li is analyzed. The reaction is treated as a quasi-free p-p knock-out collision in ^{6}Li followed by the n-α breaking-up of ^{5}He. The plane-wave impulse approximation is made in the former process and the final-state interaction theory is applied for the latter one. The ground state of ^{6}Li is described by the totally antisymmetrized α-d cluster model wave function, where the relative wave function between the α and d clusters is assumed to have a correct behavior with an inner oscillation and a long tail, which are consistent with high-energy elastic electron scattering. The theory succeeds in understanding the experimental features of this reaction consistently. It is found that the features of this reaction are entirely due to the α-d cluster structure of ^{6}Li and the unboundness of ^{5}He. In particular, in the angular correlation distribution the filling-up of the dip is due to the s-state component of extra proton in ^{6}Li and the $s_{1/2}$-wave neutron in ^{5}He, and the ratio of peak-to-valley is determined by the tail of the d-cluster wave function. It is thus, pointed out that this reaction gives detailed information on the three-body correlation of the extra nucleons and the α core in ^{6}Li. (auth)

32498 THE REACTION ^{6}Li(^{16}O,d)^{20}Ne. Heikkinen, D. W.; Feldman, W. (Stanford Univ., Calif.). Nucl. Phys., A113: 57-64(1968).

The reaction ^{6}Li(^{16}O,d)^{20}Ne was studied at $E_{^{16}O} = 20.0$ MeV. Angular distributions were obtained for levels in ^{20}Ne up to 6.72 MeV. Estimates of reduced α-particle widths were derived by estimating the direct reaction contribution to the cross section and by comparison to (α,α) scattering results. (auth)

32499 ENERGY SPECTRUM AND POLARIZATION OF PHOTONEUTRONS FROM ^{7}Li. De Marco, Angelo; Garfagnini, Raffaello; Piragino, Guido (Univ., Turin. Istituto Nazionale di Fisica Nucleare, Turin). Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur., 42: 797-802(June 1967).

The energy spectrum and polarization of photoneutrons from ^{7}Li at a bremsstrahlung endpoint energy of 85 MeV were measured at an angle of 135° using a diffusion cloud chamber filled with helium. The results were analyzed in terms of the independent-particle shell model; both L-S and j-j coupling schemes were considered. The L-S coupling scheme gave far better agreement with the experimental data than the j-j coupling scheme. (D.C.W.)

32500 DISTORTION OF NUCLEAR SPECTRA BY FINAL-STATE COULOMB INTERACTIONS. Norbeck, Edwin; Ingram, F. Duane (Univ. of Iowa, Iowa City). Phys. Rev. Lett., 20: 1178-80(May 20, 1968).

When charged-particle nuclear spectra are used to determine the location and width of an energy level in a nucleus with a moderately short lifetime for charged-particle decay, corrections for final-state Coulomb interactions can sometimes be very important. The effect is illustrated by application to the 16.62- and 16.92-MeV levels in ^{8}Be produced by the reaction ^{6}Li(^{6}Li,α)^{8}Be. (auth)

32501 ENERGY DEPENDENCE OF ISOSPIN MIXING IN THE GIANT-DIPOLE STATES OF ^{12}C AND ^{16}O. Wu, C.-P.; Firk, F. W. K.; Phillips, T. W. (Yale Univ., New Haven). Phys. Rev. Lett., 20: 1182-4(May 20, 1968).

The cross sections for the reaction ^{12}C(γ,n_0)^{11}C and ^{16}O(γ,n_0)^{15}O were measured at 90° for excitation energies up to 40 MeV. A nanosecond time-of-flight spectrometer was used. The results were compared with data for the (γ,p_0) reaction on the two nuclei. It is concluded that the giant dipole states of ^{12}C contain appreciable admixtures of T = 0 components. In ^{16}O, the major dipole states have a high degree of isospin purity. (D.C.W.)

32502 STUDY OF STATES IN ^{15}O BY THE REACTIONS ^{14}N(τ,d) AND ^{16}O(τ,α). Bohne, W.; Homeyer, H.; Morgenstern, H.; Scheer,

J. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Nucl. Phys., A113: 97-103(1968).

Angular distributions of deuterons and α-particles emitted in the reactions $^{14}N(\tau,d)$ and $^{16}O(\tau,\alpha)$ going to the first seven states in ^{15}O were measured between 5° and 120° at $E_\tau = 11$ MeV. DWBA calculations were performed and spectroscopic factors extracted and discussed. (auth)

32503 HARTREE–FOCK METHOD AND VARIATION OF PROJECTED DETERMINANTS. Dreizler, R. (Univ. of Pennsylvania, Philadelphia); Federman, P.; Giraud, B.; Osnes, E. Nucl. Phys., A113: 145-60(1968).

The results for the standard angular momentum projection of the Hartree–Fock solution (VB) are compared with those obtained from the variation of the projected determinants themselves (VA). Calculations are performed for selected states of ^{12}C, ^{20}Ne, ^{36}Ar and ^{44}Ti. In the case of ^{20}Ne several Hamiltonians are used. Comparison shows that the results obtained for the two methods are close to each other in many practical cases. (auth)

32504 GAMMA-RAY TRANSITIONS FROM THE 2.15-MeV STATES OF ^{10}B. MacDonald, Jack R.; Start, D. F. H.; Wilkinson, D. H. (Oxford Univ.). Nucl. Phys., A113: 129-33(1968).

The mixing ratio of the 2.15 MeV to 0.72 MeV transition in ^{10}B was measured to be $\delta(E2/M1) = -0.23$ or $\delta(E2/M1) = -4.1$ using a proton-gamma-ray angular correlation technique. The reduced M1 and E1 radiative widths deduced from these values are compared to those predicted by the independent-particle-model calculations of Inglis, Kurath and Cohen. (auth)

32505 CLUSTER ABSORPTION OF STOPPED π^- MESONS ON ^{12}C. Golovanova, N. F.; Zelenskaya, N. S.; El Nagar, N. (Moscow State Univ.). Nucl. Phys., A113: 1-13(1968).

Absorption of stopped π^--mesons on light nuclei are studied within the framework of a direct mechanism of meson absorption on a few-nucleon cluster in the nucleus. In particular, two processes are considered: $^{12}C(\pi^-,nt)2\alpha$ and $^{12}C(\pi^-,n^3He)^6Li$ for which the spectra and angular correlations of the final particles have been calculated. The results of the calculation are compared with the available experimental data. (auth)

32506 REACTION MATRIX ELEMENTS FOR CLOSED-SHELL NUCLEI USING REALISTIC FORCES. Grillot, D. (Univ. of Oregon, Eugene); McManus, H. Nucl. Phys., A113: 161-75(1968).

A method for calculating the reaction matrix elements of closed-shell nuclei is discussed. An improved treatment of the Pauli projection operator is proposed, and accurate solutions of the Bethe–Goldstone equation are obtained for the ^{16}O nucleus using the Hamada–Johnston potential. Solutions for the coupled and uncoupled integro-differential equations are used to obtain the first-order binding energy of the ^{16}O nucleus. The reaction matrix is examined as a function of the single-particle energies. It is found that the $^3S_1$ states are very sensitive to the choice of single-particle energies; whereas, the $^1S_0$ states are relatively insensitive to this choice. Calculated singularities of the reaction matrix are also reported for both the $^1S_0$ and $^3S_1$ states. (auth)

32507 γ–γ CASCADES OF FOUR RESONANCES OF THE REACTION $^{15}N(p,\gamma)^{16}O$. Gorodetzky, S.; Adloff, J. C.; Brochard, F.; Chevallier, P.; Disdier, D.; Gorodetzky, Ph.; Modjtahed-Zadeh, R.; Scheibling, F. (Centre de Recherches Nucleaires, Strasbourg). Nucl. Phys., A113: 221-32(1968). (In French).

The gamma decay of ^{16}O states was studied at four resonances of the $^{15}N(p,\gamma)^{16}O$ reaction in the range $E_p = 0.4$ to 1.9 MeV. For normalization purposes, the absolute cross section of the simultaneous 4.43 MeV gamma rays from the $^{15}N(p,\alpha_1\gamma)^{12}C$ reaction was also measured. (auth)

32508 FINAL STATE INTERACTIONS IN THE DECAY OF LIGHT HYPERNUCLEI. Chaudhari, K. N.; Ganguli, S. N.; Rao, N. K. (Tata Inst. of Fundamental Research, Bombay). pp 125-8 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.
See CONF-670220–(Vol.2).

From a sample of 370 uniquely identified light hypernuclei, angular correlations and relative energies between their decay products are studied. It is inferred from this study that the decay of hypernucleus ^5He, resulting from the binding of Λ hyperon to an α-particle core, which proceeds almost exclusively according to the scheme $^5He \rightarrow \pi^- + {}^1H + {}^4He$, is dominated by strong interactions between the particles present in the final state. The decay of ^5He can be described by invoking a two step reaction $^5He \rightarrow \pi^- + {}^5Li^*$, $^1H + {}^4He$, with a predominance of transitions to the 1.8 MeV, $\frac{3}{2}^-$ level of ^5Li. Similarly it is concluded from ^8Li hypernucleus, decaying according to the scheme $^8Li \rightarrow \pi^- + {}^4He + {}^4He$, that its decay proceeds through an intermediate state involving the formation and the subsequent decay of the 2.9-MeV, 2^+ excited level of ^8Be; $^8Li \rightarrow \pi^- + {}^8Be^*$, $^8Be^* \rightarrow {}^4He + {}^4He$. The final-state interactions present in the other species of light hypernuclei are also studied. (auth)

32509 ^6Li AS A THREE BODY SYSTEM. Shah, M. S. (Physical Research Lab., Ahmedabad, India); Mitra, A. N. pp 117-19 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.
See CONF-670220–(Vol.2).

^6Li nucleus has been treated as a three-body system consisting of an α-particle, a proton and a neutron interacting through non-local separable potentials whose parameters are fitted to give agreement with experimental data on α-nucleon and nucleon-nucleon scattering. The binding energy and wave function in momentum-space for the ground state T = 0 and the first excited state T = 1 are calculated. The results are discussed. (auth)

32510 ABSOLUTE CROSS SECTIONS OF (t,p) AND (^3He,p) REACTIONS. Mathur, V. S.; Rook, J. R. (Nuclear Physics Lab., Oxford). pp 210-15 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.
See CONF-670220–(Vol.2).

The absolute value of the differential cross section for the $^{16}O(t,p)^{18}O$ (g.s.) reaction is calculated in the distorted-wave approximation using Ohmura's hard-core wave function to describe the internal motion of the nucleons in the triton. A reasonable agreement with the observed value of the cross section is obtained while reproducing at the same time the observed binding energy and the size of the triton. Further, an explanation is offered for the equality of the absolute cross sections of the (p,t) and (p,^3He) reactions leading to analogue isobaric states, apart from factors depending on momentum and isospin transfer, in spite of a considerable difference in the rms charge radii of the triton and ^3He. (auth)

32511 TOTAL AND PARTIAL WIDTHS FOR LEVELS IN ^{17}O. Divatia, A. S.; Sekharan, K. K.; Mehta, M. K. (Bhabha Atomic Research Centre, Trombay, India). pp 203-9 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.
See CONF-670220–(Vol.2).

Total widths for 16 levels in ^{17}O in the excitation energy region 7.9 to 10.5 MeV were obtained from a study of the total cross section for the $^{13}C(\alpha,n)^{16}O$ reaction, for the incident alpha energy range 1.95 to 5.57 MeV, using a 4π neutron detector. Partial widths Γ_α and Γ_n and the corresponding reduced widths γ_α^2 and γ_n^2 were determined for the four levels at 8.40, 8.50, 9.19, and 9.88 MeV. A discussion of the procedures used for the evaluation of the total and partial widths is presented. (auth)

Nuclear Properties and Reactions, $20 \leq A \leq 89$

Refer also to abstracts 31535, 32061, 32468, 32494, 32496, 32572, 32574, 32581, 32596, 32629, 32638, 32643, 32647, 32661, 32697, 32698, 32725, 32726, 32728, and 32729.

32512 (AECL–3108) PHYSICS DIVISION PROGRESS REPORT, JANUARY 1–MARCH 31, 1968. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). 85p. (PR-P–77). Dep. CFSTI. CAN $2.00.

The energy levels of several medium-weight and heavy nuclei were investigated using charged particle-induced reactions and scattering, as well as beta decay. Photofission and fission induced by direct reactions were also studied. Techniques for preparing germanium were investigated, as were pulse shapes in Ge(Li) detectors. A Ge(Li) double diode (n^+-i-p-i-n^+) was constructed. Neutron scattering from vanadium dioxide was studied, as was neutron inelastic scattering from liquid helium. The investigation of spin-waves in the conical magnetic phase of erbium was continued. Methods for making shell-model calculations were developed, as were methods for analyzing accelerator fields and beam transport systems. (D.C.W.)

32513 (ANU-P–400) DEPARTMENT OF NUCLEAR PHYSICS ANNUAL REPORT, 1967. Titterton, E. W. (Australian National Univ., Canberra). Jan. 1968. 35p. Dep.

The energy levels of a number of light and medium-weight nuclei were investigated using charged-particle reactions and scattering. A program of measurements of the static quadrupole moments of excited states of nuclei was initiated. Proton energy losses in thin foils of carbon and gold were investigated. Developments in double-focusing magnetic spectrometers and semiconductor detectors are also reported. (D.C.W.)

32514 (COO-1120-71) THE $^{32}S(p,\gamma)^{33}Cl$ REACTION. Gordon, James W. (Kansas Univ., Lawrence. Nuclear Physics Lab.). May 1968. Contract AT(11-1)-1120. 90p. Dep. CFSTI.

The energy levels of ^{33}Cl were investigated using the reaction $^{32}S(p,\gamma)^{33}Cl$ at incident proton energies of 0.475 to 3.215 MeV. Gamma spectra were taken at the resonances using Ge(Li) and NaI(Tl) detectors. Gamma angular distributions were also measured; the data were fitted with Legendre expansions. The relative intensities and branching ratios for a number of gamma transitions were determined. Evidence for the existence of seven previously unreported states in ^{33}Cl at excitation energies of 1990 ± 4, 2347 ± 10, 2979 ± 4, 4440 ± 6, 4474 ± 6, 4757 ± 6, and 4844 ± 6 keV was obtained. The spins of the levels at 4474, 4757, and 4844 keV were uniquely determined to be $^3/_2$, $^5/_2$, and $^3/_2$, respectively. The spin of the resonance state at 4440-keV excitation energy is either $^1/_2$ or $^3/_2$. An ambiguity also remains of a spin assignment of $^5/_2$ or $^7/_2$ for the second excited state at 1990 keV. Similarly, assignments of $^5/_2$ and $^7/_2$ for the seventh excited state at 2979 keV were considered; the $^7/_2$ assignment appears to be more consistent with the data. Multipole mixing ratios for a number of gamma transitions in ^{33}Cl were also determined. A level scheme for ^{33}Cl that includes all the data is proposed. (D.C.W.)

32515 (JEN-181-DF/1-55) ANALISIS MAGNETICO DE LA REACCION $^{51}V(d,p)^{52}V$. (Magnetic Analysis of the Reaction $^{51}V(d,p)^{52}V$). Bolta Alandete, J. M. (Junta de Energia Nuclear, Madrid (Spain)). 1966. 21p. (In Spanish). Dep.

The protons emitted after bombardment of a vanadium target by deuterons of 10.1 MeV were analyzed using a multichannel magnetic spectrometer of high resolving power, with which 24 different scattering angles covering the angular interval from 5 to 175° were measured. The characteristic variation of energy with angle permitted identification of 38 groups of protons corresponding to the ground state and 37 excited states of ^{52}V up to an energy of 3.66 MeV. The values obtained are in perfect agreement with previously published results; seven new levels are quoted for the first time. The experimental angular distributions for all these levels were also calculated. These distributions which are, in general, well-defined over a wide angular interval, have been analyzed using distorted-wave theory (DWBA), except for a few cases in which the cross section was very small. Thus reduced widths and the value of the angular momentum with which the neutron is captured for the corresponding levels were obtained. The results show general agreement with the nuclear shell model according to which the first free levels for the capture neutrons are $2p_{3/2}$, $1f_{5/2}$, $2p_{1/2}$. (auth)

32516 (MIT-2098-422, pp 43-68) O.N.R. GENERATOR GROUP. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science).

The energy levels of a number of light-medium weight nuclei were investigated using charged-particle reactions and scattering. A carbon polarimeter for measurement of isobaric analog state spins was developed. (D.C.W.)

32517 RELATIVE NEUTRON CROSS SECTIONS FOR THE PRODUCTION OF ^{24m}Na FROM MAGNESIUM AND ALUMINUM. Salaita, George N. (Southern Methodist Univ., Dallas). Przewlocki, K.; Givens, W. W.; Mills, W. R. Trans. Amer. Nucl. Soc., 11: 21(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32518 SHELL MODEL CALCULATION IN THE CALCIUM ISOTOPES. Osnes, E.; Engeland, T. (Univ. of Oslo). Phys. Norv., 2: 231-40(1967).

Shell model calculations are performed for the calcium isotopes assuming an effective interaction in the $1\ f_{7/2}^{n}$ and $1\ f_{7/2}^{n-1}\ 2p_{3/2}$ configurations. Both binding energies and level schemes are calculated in a least squares fit approach. Good agreement is obtained, particularly in the odd isotopes. The calculation is reproduced with the surface delta interaction with one unknown parameter. The results show that this force is not able to describe the energy spectra and relative binding energies. (auth) (NORWAY)

32519 NUCLEAR MAGNETIC MOMENT OF ^{37}K. Besch, H. J.; Koepf, U.; Otten, E. -W.; von Platen, Ch. (Univ., Heidelberg). Phys. Lett., 26B: 721-2(May 13, 1968).

The hyperfine splitting of the atomic ground state of the $\tau_{1/2}$ = 1.2 s isotope ^{37}K was measured by the recently developed method of optical pumping of short-lived β-emitters yielding $\Delta\nu(^{37}K)$ = 240.503 + 0.003 MHz. The magnetic moment was calculated to be $\mu_I(^{37}K) = (0.2036^{+0.0001}_{-0.0005})$ nm including a possible error for hyperfine anomaly. The maximum observed asymmetry was −2%. (auth)

32520 BETA AND GAMMA RAY STUDIES OF SHORT LIVED ISOTOPES IN THE 2s–1d SHELL. Armini, Anthony John. Los Angeles, Univ. of California, 1967. 108p.

Thesis.

The short-lived beta and gamma spectra of ^{20}Na, ^{24}Al, ^{28}P, ^{32}Cl, and ^{40}Sc were measured with a single wedge gap magnetic spectrometer and a Ge(Li) detector. These isotopes were produced by proton-induced reactions on the even-even $T_z = 0$ nuclei in the 2s-1d shell. Background and contaminants were separated from these short-lived isotopes at each positron momentum by an on-line computer. The complete decay schemes are presented, including the ground-state masses and the first T = 1 analog states in the daughter nuclei. These isotopes lie in an interesting transition region between the deformed (^{20}Na and ^{24}Al) and the spherical nuclei (^{40}Ca). (Disser. Abstr.)

32521 SHELL-MODEL CALCULATIONS FOR A = 20 TO 28 NUCLEI. Wildenthal, B. H.; McGrory, J. B.; Halbert, E. C.; Glaudemans, P. W. M. (Oak Ridge National Lab., Tenn.). Phys. Lett., 26B: 692-4(May 13, 1968). (ORNL-P-3722).

Levels for nuclei with $20 \leq A \leq 28$ were calculated in a $1d_{5/2}$–$2s_{1/2}$ shell-model scheme. The two-body matrix elements and single-particle energies employed were determined empirically from a least-squares fit to 80 level energies. Some examples of the results are presented. (auth)

32522 DEFORMED CONFIGURATION MIXING MODEL FOR SOME s-d SHELL NUCLEI. Satpathy, L.; Nair, S. C. K. (Saha Inst. of Nuclear Physics, Calcutta). Phys. Lett., 26B: 716-18 (May 13, 1968).

The existence of large energy gaps between occupied and unoccupied Hartree-Fock states in even-even N = Z nuclei in the s-d shell provides the basis for a configuration mixing model in the intrinsic k-space of the valence nucleons outside the even-even core. The application of this model to ^{22}Ne yields excellent results for the energy spectrum. (auth)

32523 THEORY OF CORE EXCITATION COMPONENTS IN THE GROUND STATES OF THE CALCIUM ISOTOPES. Zamick, L. (Rutgers–The State Univ., New Brunswick, N. J.). Ann. Phys. (N.Y.), 47: 182-201(1968).

Wave functions of the ground states of the calcium isotopes are calculated. The configurations are restricted to $f_{7/2}^{(n)JT}$ and $[d_{3/2}^{-2}\ I_H\ T_H f_{7/2}^{(n+2)}\ I_P\ T_P]\ JT$ where I_H, T_H, I_P, T_P are the angular momenta and isobaric spins of the two holes and (n + 2) particles respectively. Using the abbreviated notation $[T_H T_P]\ T$ for the core excitation components, it is shown that the matrix elements between these components and the shell-model states $f_{7/2}^{(n)}$ assume a very simple form for all possible T_H, T_P and n. A relation between the neutron and proton strengths in (d, p) reactions to opposite parity states and the average number of neutron holes and proton holes in the ground states of the calcium isotopes is worked out and is discussed in simple physical terms. It is found that the $[T_H = 1\ T_P = T + 1]\ T$ states are mainly responsible for the neutron strengths in (d, p) reactions, whereas the $[T_H = 1\ T_P = T - 1]T$ states contribute most to the proton strengths in (^3He, d) reactions to opposite-parity states. In order to reproduce the experimental trend in which the neutron strength decreases as one goes through the even calcium isotopes one must choose the energies of the $[T_H = 1\ T_P = T + 1]T$ states to be an increasing function of n. This is contrary to a previous prediction by this author. The work of Gerace and Green on the calcium isotopes is discussed and is compared with the present work. Much smaller neutron strengths for the (d, p) reactions in ^{40}Ca and ^{42}Ca to $J = {^3/_2}^+$ states are obtained in the present work than are obtained by some of the experimentalists. For example, the reaction ^{40}Ca (d, p) ^{41}Ca $J = {^3/_2}^+$ state has 0.78 as the value of the neutron strength according to Belote et al. In the present model, this would imply that the percentage of core-excitation component in the ground state of ^{40}Ca is at least 78%. (auth)

32524 TEST OF THE ^{235}U THERMAL FISSION SPECTRUM REPRESENTATIONS BY MEANS OF ACTIVATION DETECTORS. Fabry, A. (CEN–SCK, Mol, Belg.). Nukleonik, 10: 280-2(Nov. 1967).

Absolute measurements of fission spectrum-averaged cross sections for a few threshold and capture reactions were performed by the activation technique under experimentally controlled conditions of neutron background. These measurements indicate, in agreement with other integral studies reported recently at Los Alamos, that the ^{235}U thermal fission spectrum is significantly harder than according to differential data based on n–p scattering. (auth)

32525 QUASI-INELASTIC (^3He,t) REACTION. Frahn, W. E.; Wiechers, G. (Univ. of Cape Town). Nucl. Phys., A113: 593-7 (1968).

A combined analysis of the angular distributions for elastic, inelastic, quasi-elastic, and quasi-inelastic scattering in the

^{3}He + ^{48}Ti system at 25 MeV is presented, involving transitions between the ground and 2^+ excited states in ^{48}Ti and their isobaric analog states in ^{48}V. The analysis is made by means of a closed formalism based upon an extension of the Austern–Blair theory and the strong absorption model. The results strongly suggest that the quasi-inelastic scattering contains equal contributions from one-step and two-step processes. (auth)

32526 SCATTERING OF 6-MeV NEUTRONS FROM LIGHT NUCLEI. Martin, J. (Univ. of Glasgow); Stewart, D. T.; Currie, W. M. Nucl. Phys., A113: 564-80(1968).

Differential cross sections for both elastic and inelastic neutron scattering were measured for natural targets of Al, Si, P, and S at an incident energy of 5.95 MeV. The elastic scattering results are compared with the predictions of the Perey–Buck nonlocal optical model in combination with statistical model estimates of the compound elastic scattering. The over-all agreement was satisfactory, provided that the effects of neutron level width fluctuations were incorporated in the statistical calculations. The inelastic scattering was interpreted mainly by the statistical calculations and also, where collective excitation was expected to be important, by direct interaction predictions calculated with a coupled-channels computer program. Through this procedure, the agreement between theory and experiment proved to be reasonably good for three of the nuclei studied, the only exception being ^{27}Al, where appreciable discrepancies exist. On the basis of the statistical calculations it was also possible to attribute a definite spin and parity to the 4.46-MeV level in ^{32}S. (auth)

32527 THE $(f_{7/2}^{-1}\,f_{7/2})2^+$ STATE IN ^{48}Sc. Wong, S. S. M. (Univ. of Alberta, Edmonton). Nucl. Phys., A113: 481-3(1968).

A low-lying $(f_{7/2}^{-1}\,f_{7/2})\ 2^+$ state in ^{48}Sc is found to be consistent with the particle-hole transformation of the complete $(f_{7/2})^2$ spectrum in ^{42}Sc and with the available data on ^{48}Sc. (auth)

32528 EFFECT OF DEFORMED STATES IN THE Ca ISOTOPES. II. ODD PARITY STATES OF ^{40}Ca. Gerace, W. J.; Green, A. M. (Princeton Univ., N. J.). Nucl. Phys., A113: 641-58(1968). (PUC–937-286).

An attempt is made to explain the odd-parity states of ^{40}Ca in a manner similar to that used earlier for the even-parity states. In this model low-lying deformed states are mixed with shell-model states using the Hamada–Johnston nucleon–nucleon interaction. Of primary importance in this description is the fact that the particle-hole energy differences which are found by requiring consistency with the previous even-parity work are significantly smaller than those usually used in shell model calculations in which the ground states of ^{39}Ca, ^{40}Ca, and ^{41}Ca are assumed to be good shell-model states. Wave functions for the lowest odd-parity states and some predicted transition rates are given. (auth)

32529 EXCITATION OF MOESSBAUER LEVELS WHEN HEAVY IONS ARE DECELERATED. Gol'danskii, V. I.; Dalidchik, F. I.; Ivanov, G. K. (Inst. of Chemical Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.), 7: 138-41(Mar. 1968).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 7: 180-4(Mar. 5, 1968).

The probability of the excitation of nuclear levels in the nuclei of accelerated ions by Coulomb excitation in the attenuation of the beam is calculated. As an example, the probabilities for excitation of Moessbauer levels in ^{19}F and ^{57}Fe by deceleration in different media were calculated. (D.C.W.)

32530 CROSS SECTION FOR SOME FAST NEUTRON INDUCED REACTIONS AND THE STATISTICAL MODEL. Tiwari, P. N.; Kondaiah, E. (Tata Inst. of Fundamental Research, Bombay). pp 345-52 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

Cross sections for the ^{39}K(n,2n)^{38}K$_{g.s.}$, ^{41}K(n,p)^{41}Ar, and ^{41}K(n,α)^{38}Cl reactions have been measured at $E_n = 14.2 \pm 0.2$ MeV by the activation technique. The half-life of ^{38}K$_{g.s.}$ was found to be 8.9 min as opposed to 7.6 min reported by other authors. All the (n,p), (n,α), and (n,2n) cross sections measured in this series have been calculated theoretically on the statistical model using optical potential penetrabilities. The agreement between experiment and theory is good for the value of level density parameter equal to A/8. (auth)

32531 FLUCTUATIONS IN THE INTEGRATED CROSS SECTION OF THE REACTION ^{45}Sc(p,n)^{45}Ti. Iyengar, K. V. K. (Tata Inst. of Fundamental Research, Bombay); Gupta, S. K.; Sekharan, K. K.; Mehta, M. K.; Divatia, A. S. pp 304-9 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

The integrated cross section of the reaction ^{45}Sc(p,n)^{45}Ti as a function of incident proton energy was measured in the energy interval 2.910 to 5.250 MeV with energy steps of 5 keV. The overall energy resolution was of ~3.5 keV. The excitation function shows fluctuations around an average. This average increases with proton energy. The statistical theory of Ericson was applied; the autocorrelation was calculated and was used to determine the average width of levels in the compound nucleus ^{46}Ti in the excitation energy range 13.230 to 15.140 MeV. The analysis yields an average width $\langle\Gamma\rangle$ of 6 keV corresponding to a compound nucleus lifetime of 1.1×10^{-19} sec. (auth)

32532 FLUCTUATION ANALYSIS OF THE COMPOUND NUCLEUS LEVELS OF ^{52}Cr. Lamba, C. M. (Bhabha Atomic Research Centre, Trombay, India); Sarma, N.; Thampi, N. S.; Sood, D. K.; Deshpande, V. K. pp 292-8 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

The fluctuations in the cross section of the reaction ^{51}V(p,p) due to the levels in ^{52}Cr were investigated. The excitation functions at four angles were measured in the energy range 4.0 to 5.5 MeV. The width of the fluctuations was computed using the autocorrelation function and the more accurate method of Corti. Strong modulation effects are found to be present and the nature of the modulation has been studied using the method of moving averages. The values on N and Y_D were also extracted from the autocorrelation method and from probability distribution analysis. The effect of FRD errors was also calculated, and it is shown that the final results are unaffected by this cause. (auth)

32533 ^{51}V(p,n)^{51}Cr REACTION BETWEEN 1.56 AND 5.53 MeV. Sekharan, K. K.; Mehta, M. K.; Divatia, A. S. (Bhabha Atomic Research Centre, Trombay, India). pp 300-3 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

The relative yield of neutrons for the ^{51}V(p,n)^{51}Cr reaction was measured with fine resolution for the incident energy range 1.56 to 5.53 MeV using a 4π neutron counter. The excitation function shows a large number of peaks superimposed on a rapidly rising background. The data have been analyzed according to the statistical fluctuation theory. (auth)

32534 BAND-MIXING CALCULATIONS IN ^{25}Al. Gunye, M. R. (Bhabha Atomic Research Centre, Trombay, India). pp 245-9 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

The Hartree-Fock calculations with the phenomenological internucleon residual interaction in the form of Rosenfeld mixture with Yukawa radial dependence are carried out for $K = 5/2$ and $K = 1/2$ bands of ^{25}Al. The low-lying excited states of ^{25}Al are obtained by projecting out good angular momentum states from the deformed Hartree-Fock states. Since the two bands in the projected energies are quite close, the interaction between the projected states has to be taken into account. The projected energy spectrum, after taking into account the band mixing, is in fair agreement with the experimental energy spectrum. (auth)

32535 ONE- AND THREE-QUASI-PARTICLE STATES OF THE Ni ISOTOPES. Gambhir, Y. K.; Raj, Ram (Saha Inst. of Nuclear Physics, Calcutta). pp 252-8 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

An extended Tamm-Dancoff approximation (ETDA) has been proposed for the description of the states of the odd-A nuclei as the superposition of one- and three-quasiparticle states. The three quasiparticle states are classified according to the well-known seniority scheme and are expressed in an equivalent second quantized form which are free from the two basic defects namely, the redundancy and non-orthonormality of the three quasi-particle basis states. The spurious states must be projected out before the diagonalization of the energy matrix in one and three-quasi-particle subspaces. The results for ^{59}Ni are compared. (auth)

32536 MEASUREMENT OF (n,2n) CROSS SECTIONS OF FAST NEUTRONS. Chatterjee, Arun; Nath, A.; Ghose, A. M. (Bose Inst., Calcutta). pp 363-6 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220-(Vol.2).

The cross sections for (n,2n) reactions on ^{63}Cu, ^{19}F, ^{69}Ga, ^{107}Ag, and ^{64}Zn at an incident neutron energy of 14.8 MeV were measured. The fast neutron flux was measured absolutely using a heavily biased plastic scintillator; and the absolute value of the positron activity was measured using an NaI(Tl) coincidence spectrometer. The values obtained for the cross sections were compared with other values reported in the literature. (D.C.W.)

32537 ISOMERIC CROSS-SECTION RATIO FOR (n,γ) REACTION AT 24 keV. Chaubey, A. K.; Sehgal, M. L. (Aligarh Muslim Univ., India). pp 521-9 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220-(Vol.2).

Isomeric cross-section ratios were previously measured for the capture of 24-keV neutrons by ^{68}Zn, ^{76}Ge, ^{80}Se, ^{79}Br, ^{103}Rh, ^{115}In, and ^{130}Te. The semi-empirical rule of Mateesian and Goldhaber was verified. Using the spin distribution form due to Bethe and Block, isomeric cross-section ratios were calculated in all the above cases, to obtain an idea of the level density parameter σ. In the case of ^{79}Br, the value of σ was calculated at different energies to see the energy dependence of σ. It was observed that σ varies slowly with energy of incident neutrons. Similar calculations are in progress for the cases of ^{103}Rh and ^{115}In. (auth)

32538 GAMMA–GAMMA DIRECTIONAL CORRELATIONS IN ^{82}Kr. Bajaj, M. M.; Gupta, S. L.; Saha, N. K. (Univ. of Delhi). pp 488-94 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220-(Vol.2).

The gamma-gamma directional correlation measurements of the three cascades 1648-777, 1317-777 and 619-1475 keV in ^{82}Kr following the beta decay of 36 h ^{82}Br were made using the coincidence method. The measurements favor spins of 2,2,3, and 3 for the 777-, 1475-, 2094-, and 2425-keV levels, respectively. The 1648-keV radiation was found to be predominantly quadrupole in character with a dipole admixture of ~10%. The E2 and M1 transition probabilities for the 1317-keV radiation were compared with the corresponding single-particle estimates. (auth)

32539 ISOMERIC CROSS SECTION RATIOS FOR (n,2n) REACTIONS AT 14.8 MeV. Prasad, R.; Sarkar, D. C. (Muslim Univ., Aligarh, India). pp 374-8 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220-(Vol.2).

Isomeric cross-section ratios at 14.8 MeV for (n,2n) reactions in the following isomeric pairs, ^{34,34m}Cl; ^{44,44m}Sc; ^{91,91m}Mo; and ^{114,114m}In were measured. Using the compound-nucleus mechanism and the spin distribution form due to Bethe and Block, theoretically calculated isomeric ratios were compared with the measured values to find the most probable value of the spin distribution parameter σ. This parameter was also calculated from the classical rigid moment of inertia of the nucleus. (auth)

32540 INTRINSIC STATES IN ^{42}Ca$_{22}$ AND ^{58}Ni. Bhatt, K. H. (Physical Research Lab., Ahmedabad, India); Parikh, J. C. pp 272-7 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220-(Vol.2).

It is shown that axially symmetrically deformed intrinsic states exist for these nuclei such that the states with definite angular momenta generated from them, using Elliott's procedure, have excellent overlaps with the corresponding states obtained by shell-model calculations. A method of determining the intrinsic states in analogy with the structure of the single-particle states in a Q_0^2 quadrupole field, in the absence of spin-orbit interaction, is suggested. (auth)

32541 STUDY OF THE Ar(n,p)Cl REACTION. Jhingan, M. L.; Rivetna, Roshan; Kondaiah, E. (Tata Inst. of Fundamental Research, Bombay). pp 422-6 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220-(Vol.2).

The energy and angular distribution of protons arising from the ^{40}Ar(n,p)^{40}Cl reaction at E_n = 14 MeV were studied using nuclear emulsion as the detector. Allan's geometry was chosen for this study. The measured angular distribution is more or less symmetric around 90° in the center-of-mass system. (auth)

32542 LEVEL SPECTRA OF Ni ISOTOPES WITH REALISTIC INTERACTION. Gambhir, Y. K. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Lett., 26B: 695-9 (May 13, 1968).

Quasiparticle configuration-mixing calculations are made for the Ni isotopes with an approximate reaction matrix of Hamada–Johnston potential reported by Kuo. The results are very close to those obtained by the exact shell-model calculations, but the agreement with the experimental spectra is poor in both these cases. A remarkable improvement is achieved in the quasiparticle results when the renormalized force strength and the quasiparticle quantities extracted by the inverse gap equation procedure are used. A possible further improvement in the inverse gap equation procedure is discussed. (auth)

32543 ISOSPIN STRUCTURE OF LOW-LYING Ti STATES. Soga, M.; Horoshko, R. N.; Van Patter, D. M. (Bartol Research Foundation, Swarthmore, Pa.). Contract AT(30-1)-3525. Phys. Lett., 26B: 727-9(May 13, 1968). (NYO-3525-29).

The 3_1^- state of ^{46}Ti exhibits unusual γ-decay properties, with E1 decay to the 2_2^+ state being highly preferred. A theoretical investigation of the isospin structure of the first two 2^+ states in ^{44,46,48}Ti provides a qualitative explanation of this observation. (auth)

32544 DELAYED HEAVY PARTICLE EMITTERS ^{24}Al AND ^{32}Cl. Steigerwalt, John Eugene. Los Angeles, Univ. of California, 1967. 105p.

Thesis.

The energy spectra of the delayed heavy particles emitted from levels in ^{24}Mg and ^{32}S following their population by the beta decay from ^{24}Al and ^{32}Cl, respectively, are presented. The alpha transitions from the 11.23-MeV, 11.70-MeV, and 12.13-MeV levels in ^{24}Mg were measured in addition to the alpha transitions from the 8.79 and 9.47-MeV levels in ^{32}S. Proton transitions were measured from the 9.65-MeV, 9.91-MeV, and 10.26-MeV levels of ^{32}S. The relative intensities of the β^+ decays to the heavy particle emitting levels were measured as well as an absolute β^+ branching ratio to the alpha particle unstable levels of ^{24}Mg. Two systems are described which analyze the particle spectrum of short lived, heavy particle emitting isotopes. One of these utilizes a chamber in a pulsed external beam, and the other shuttles a target between the internal beam of the cyclotron and radiation detectors external to the cyclotron. The energy levels deduced in ^{24}Mg and ^{32}S are compared with known energy levels and assigned possible spin and parity values. These assignments are compared with spin and parity values when known. (Disser. Abstr.)

32545 THE REACTION ^{27}Al(d,α)^{25}Mg. Hofmann, A.; Emmerich, W.; Dinter, H.; Philipp, G. (Univ., Erlangen-Nuernberg, Ger.). Nucl. Phys., A113: 86-96(1968). (In German).

In the energy region E_d = 4 to 20 MeV, the ^{27}Al(d,α)^{25}Mg cross section can be separated into a direct and a compound nucleus contribution. At each energy, the direct contribution is found to be constant for α-groups corresponding to states of the same rotational band of the residual nucleus. The compound nucleus contribution follows the (2I + 1) rule in the whole energy region. The direct contribution to the cross section, determined from our measurements at E_d = 4.74, 9.2 and 10.1 MeV and from measurements of others, is given as a function of bombarding energy. (auth)

32546 ENERGIES AND INTENSITIES OF γ RAYS FROM THERMAL NEUTRON CAPTURE BY STRONTIUM. Irigaray, J. L. (CEN, Bordeaux); Petit, G. Y.; Carlos, P.; Maier, B.; Samama, R.; Nifenecker, H. Nucl. Phys., A113: 134-44(1968). (In French).

The neutron capture γ-ray spectra of the reaction Sr(n,γ) were investigated using a Ge(Li) spectrometer. A pure thermal neutron beam is obtained by Bragg reflection from a lead crystal. A total of 144 gamma lines was observed. A neutron separation energy of 8428.5 ± 2.5 keV for ^{87}Sr and 11,113.5 ± 1.5 keV for ^{88}Sr was deduced. The intensities per 100 neutrons captured were evaluated for a large number of transitions, specially in ^{88}Sr. A transition scheme is proposed and discussed for ^{87}Sr and ^{88}Sr. (auth)

32547 A STUDY OF THE ^{75}As(n,γ)^{76}As REACTION. Johnson, L. V.; Kennett, T. J. (McMaster Univ., Hamilton, Can.). Nucl. Phys., A113: 104-28(1968).

The ^{75}As(n,γ)^{76}As reaction was studied using Ge(Li) and Ge(Li)–NaI(Tl) spectrometers. A total of 155 gamma rays above 4 MeV and 102 gamma rays below 1 MeV were observed and their energy and intensity determined. No gamma transition from the neutron capture state to the ^{76}As ground state was observed. In order to determine a consistent neutron separation energy it was necessary to derive a detailed decay scheme for ^{76}As. To facilitate this derivation a coincidence experiment was also conducted. The neutron separation energy was determined to be 7329 ± 2 keV. (auth)

32548 Cu(d,^{3}He)Ni REACTIONS AT 34.2 MeV. Hiebert, J. C. (Texas A and M Univ., College Station); Newman, E. Nucl. Phys., A113: 176-92(1968).

Deuterons accelerated to 34.2 MeV were used to investigate (d,^{3}He) reactions on ^{63}Cu and ^{65}Cu. Angular distributions were compared with local zero-range DW calculations from which the transferred angular momenta and spectroscopic factors were deduced. Strong excitation of the first excited states of the residual nuclei was observed in disagreement with model calculations. (auth)

32549 ANGULAR DISTRIBUTIONS OF GAMMA RAYS FOLLOWING (α,n) AND (p,n) REACTIONS. Birstein, L.; Chechik, R.; Drory, Ch.; Friedman, E.; Jaffe, A. A.; Wolf, A. (Hebrew Univ., Jerusalem). Nucl. Phys., A113: 193-205(1968).

The angular distributions of gamma rays excited by both (p,n) and (α,n) reactions leading to the final nuclei ^{59}Ni, ^{63}Zn and ^{66}Ga were investigated. The observed angular distributions are consistent with those theoretically predicted by the compound nucleus statistical model whenever the spin sequence is previously known. The (p,n) and (α,n) reactions yield identical values of the multipole mixing ratios for all the transitions. The variation of the gamma-ray angular distributions with incident energy following the (p,n) reaction is correctly predicted by the model. The energies of the low-lying levels of ^{66}Ga were accurately determined, and the first excited state at 175 keV excitation is found to have a spin $2^{(+)}$. The results indicate that the level at 375 keV is probably a doublet. (auth)

32550 PARAMETRIC FIT OF THE TOTAL NEUTRON CROSS SECTION OF MANGANESE FROM 0.01 eV TO 50 keV. Stephenson, Thomas E.; Pearlstein, Sol (Brookhaven National Lab., Upton, N. Y.). Nucl. Sci. Eng., 32: 377-84(1968).

Early work ascertained that the Mn total cross section could not be fit by the Breit–Wigner single-level formula. Later work showed that a satisfactory fit below 10 keV could be achieved by the use of R-matrix analysis. Recent resonance data and the Breit–Wigner multilevel formula are used to fit the experimental data from 0.01 eV to 50 keV. Two bound levels and several positive energy levels are introduced in order to produce very good agreement with the measured total cross section. The parametric representation of the ^{55}Mn cross section yields calculated values of 13.4 and 15 b for the capture 2200 m/sec cross section and resonance integral, and 1.94, 1.71, and 556 b for the thermal-bound atom, coherent-scattering cross section, and scattering resonance integral, respectively, all values being in good agreement with experiment. Qualitative agreement is obtained with polarization data. (auth)

32551 SPECTROSCOPY OF ODD–ODD NUCLEI WITH DIRECT (d,α) REACTIONS. Daehnick, W. W.; Park, Y. S. (Univ. of Pittsburgh). Phys. Rev. Lett., 20: 110-13(Jan. 15, 1968).

The question of the extent to which direct deuteron-transfer reactions, in particular of the type (d,α) and (α,d), can uniquely determine J, π, and T of unknown levels in odd–odd nuclei is investigated. Differential cross sections are given for the ^{65}Cu (d,α)^{63}Ni and ^{68}Zn(d,α)^{66}Cu reactions, and the structures associated with the curves are discussed. (S.F.L.)

32552 THE (n,p) CROSS SECTIONS OF TITANIUM ISOTOPES FOR NEUTRON ENERGIES BETWEEN 13.6 AND 19.5 MeV. Pai, Hsiang Lin. Toronto, Univ. of Toronto, 1966.

Thesis.

An experimental investigation of the (n,p) cross sections for ^{46}Ti, ^{47}Ti, ^{48}Ti, ^{49}Ti, and ^{50}Ti was made in order to clarify several points of Bodansky's explanation, based on the statistical model, of the experimentally observed decrease in the cross section by a factor of approximately 2 with unit increase in the neutron occupation number. (D.C.W.)

32553 GAMMA RAYS FROM ^{55}Mn(p,nγ)^{55}Fe REACTION. Iyengar, K. V. K.; Lal, B.; Gupta, S. K. (Tata Inst. of Fundamental Research, Bombay). pp 194–200 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol. 2).

A search was made for levels at 510 and 680 keV in ^{55}Fe produced in the reaction ^{55}Mn(p,n)^{55}Fe by observing the direct gamma rays and also the gamma rays in coincidence with neutrons exciting the levels from which the gammas were emitted. No evidence was observed for the existence of these two levels. The angular distribution of the gamma rays from the 930-keV level to the groundstate of ^{55}Fe was measured at E_p = 2.4 and 3.5 MeV and that of the gamma rays from the 1.32-and 1.41-MeV levels to the ground state of ^{55}Fe at E_p = 3.5 MeV only. These angular distributions are compared with the predictions from Satchler's theoretical formalism. (auth)

32554 ESTIMATION OF THE (t,p) REACTION REDUCED WIDTHS FROM SURFACE–DELTA INTERACTION WAVE-FUNCTIONS. Rao, K. V. Chalapati; Mukherjee, P. (Saha Inst. of Nuclear Physics, Calcutta). pp 93-8 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

Surface-delta interaction (SDI) of the type $V(\bar{r}_1-\bar{r}_2) = \delta(\bar{r}_1-R)\delta(\bar{r}_2-R)V_0$ is used as the residual interaction for the construction of the energy level structures of ^{18}O, ^{30}Si, ^{50}Ca and ^{58}Ni in the jj-coupling scheme. A major consequence of its use is that all the radial integrals are equal for a particular nucleus. To check the wave functions obtained from the SDI, an attempt is made to extract from them the information relevant to double-transfer reactions, specifically (t,p) reactions. Data on L = 0 (t,p) transitions in medium-weight nuclei show that when the ratio of excited state intensity to ground-state intensity is plotted against the neutron number of the residual nucleus, it shows a sharp fall beyond N = 28. Theoretically, the cross-sections are determined by the structure factor, G given by $G_{NLSJT} = g\Sigma_\gamma \beta_{\gamma LSJT}(j_1j_2)\cdot\Omega\ \langle n_0, NL; L/n_1l_1, n_2l_2; L\rangle$. The parentage factors β for configuration-mixed wave functions are determined by the wave functions of the residual nuclei. Using SDI wave functions for the nuclei ^{18}O, ^{30}Si, ^{50}Ca and ^{58}Ni, the values of β for the reactions ^{16}O(t,p)^{18}O, ^{28}Si(t,p)^{30}Si, ^{48}Ca(t,p)^{50}Ca and ^{56}Ni(t,p)^{58}Ni are calculated and the values of the cross-section ratios have been computed. The ratios show the expected trend of variation. (auth)

32555 PROJECTED HARTREE–FOCK SPECTRA FOR FINITE NUCLEI. Warke, Chindhu S. (Tata Inst. of Fundamental Research, Bombay). pp 232-44 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

An attempt is made to determine whether the Hartree–Fock theory, together with angular momentum projection, is a useful approximation to the configuration mixing calculations which rapidly become too complicated as the number of particles and the number of shells increase. (D.C.W.)

32556 ASYMMETRY OF THE ANGULAR DISTRIBUTION OF PROTONS FROM THE REACTION ^{40}Ca(d,p)^{41}Ca WITH POLARIZED DEUTERONS. Klimenko, A. S.; Mal'ko, A. I.; Saltykov, L. S.; Chirko, V. I. (Inst. of Physics, Kiev). Ukr. Fiz. Zh., 13: 337-8(Feb. 1968). (In Russian).

Polarized deuterons (11.2 MeV), obtained by selecting 13.8-MeV deuterons scattered on carbon at an angle of 30°, struck a thin calcium target having a thickness of about 27 mg/cm^2. The angular dependences of the asymmetry, polarization, and proton radial profile were measured. The shape of the angular cross-section distribution and the angular dependence of proton polarization from the ^{40}Ca(d,p)^{41}Ca reaction with formation of the ^{41}Ca nucleus in the ground state varied only slightly for 9- to 11-MeV deuterons. This fact indicates that the direct interaction mechanism predominates in this reaction. The proton polarization was negative. Thus the spin-orbit interaction plays an important role in the reaction ^{40}Ca (d,p)^{41}Ca. (TTT)

32557 STUDY OF THE 1.94-MeV STATE IN ^{27}Mg BY MEANS OF THE REACTION ^{26}Mg(d,pγ)^{27}Mg. Eswaran, M. A.; Ragoowansi, N. L.; Sekharan, K. K. (Bhabha Atomic Research Centre, Trombay, India). pp 174-80 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

Proton-gamma ray angular correlation measurements employing the method of Litherland and Ferguson were made in the reaction ^{26}Mg(d,p,γ)^{27}Mg. Using 1.80-MeV deuteron beam, the protons feeding the 1.94-MeV state were detected at 0° to the beam, and the angular correlations of the de-excitation gamma rays from the state were measured. The combined angular correlation of the two unresolved gamma rays due to the transitions 1.94 → 0.98 MeV and 0.98 → 0 MeV was analyzed by means of a computer programme. The χ^2 analysis of the results shows that spin choice of $5/2$ for the 1.94-MeV state gives the best fit for the observed correlation. The cascade to cross over branching ratio of this state is obtained as 2.0 ± 0.3. (auth)

32558 ANGULAR DISTRIBUTION STUDIES ON ^{56}Fe(p,p'γ) RADIATIONS. Trehan, P. N.; Mangal, P. C. (Punjab Univ., Chandigarh, India). pp 164–73 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol. 2).

The angular distribution of radiations from certain levels of ^{56}Fe excited by (p,p'γ) reaction was measured and the results were compared with the theoretical results obtained from statistical model. The information obtained from this comparison regarding the mixing ratio of some gamma-ray transitions and spin assignments to some levels of ^{56}Fe are discussed. (auth)

32559 STUDY OF LEVELS IN ^{28}Si. Kerekatte, S. S.; Divatia, A. S.; Mehta, M. K.; Nambiar, K. B.; Sekharan, K. K. (Bhabha Atomic Research Centre, Trombay, India). pp 158-61 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

Levels in ^{28}Si near 14 MeV were studied by the elastic scattering of alpha particles by ^{24}Mg. The excitation function was measured in 2- to 5-keV steps over seven resonances corresponding to excited states in ^{28}Si at 13.912, 13.963, 14.160, 14.417, 14.387, 14.448, and 14.627 MeV. From the behavior of the excitation curve at four selected angles, the levels at 14.417 and 14.387 MeV can be assigned a spin and parity of 4^+. Similarly, the levels at 14.448 and 14.627 MeV can be assigned odd spin and parity. (auth)

32560 ISOMERIC RATIOS IN FAST NEUTRON CAPTURE REACTION ON THE ^{80}Se ISOTOPE. Tolstikov, V. A.; Koroleva, V. P.; Kolesov, V. E. At. Energ. (USSR), 24: 187-90(Feb. 1968). (In Russian).

The reaction T(p,n)^{3}He carried out on a Van de Graaff accelerator served as a source of fast neutrons which were monitored by a ^{235}U fission chamber. The induced activity was measured on an end-window beta counter. The cross section σ_g for the formation of the ground-state activity ^{81g}Se ($T_{½}$ = 18 min) and the cross section σ_m for the formation of the metastable state activity ^{81m}Se ($T_{½}$ = 57 min) were determined as a function of neutron energy. The isomeric ratio $\sigma_m/(\sigma_m + \sigma_g)$ was also plotted as a function of neutron energy. It was found that the isomeric ratio increased by a factor of 2 from 0.45 at 0.2 MeV neutron energy to 0.9 at 3.1 MeV neutron energy. The value of the isomeric ratio is only 0.114 for thermal neutrons. Thus, with increasing neutron energy, the relative probability of forming the metastable state ^{81m}Se (spin $^7/_2$) increased continuously at least up to a neutron energy E_n = 3.1 MeV. (TTT)

32561 METHOD FOR STUDYING γ RAY SPECTRA IN (n,n'γ) REACTION IN SMALL SCATTERERS. Sit'ko, S. P.; Strizhak, V. I. (Kiev State Univ.). Prib. Tekh. Eksp., No. 6, 45-8(Nov.-Dec. 1967). (In Russian).

A method is suggested for studying γ-ray spectra in (n,nγ) reactions taking place in small specimens. The 2.75-MeV neutrons were obtained from reaction D(d,n)^{3}He; the energy range of the examined γ rays was from 0.35 to 2.2 MeV. (tr-auth)

Nuclear Properties and Reactions, A ≥ 90

Refer also to abstracts 30866, 31535, 32438, 32468, 32477, 32496, 32512, 32513, 32524, 32536, 32537, 32539, 32561, 32573, 32662, 32666, 32694, 32697, 32702, 32720, 32725, and 32728.

32562 (AE–314) ACTIVATION DOPPLER MEASUREMENTS ON ^{238}U AND ^{235}U IN SOME FAST REACTOR SPECTRA. Tiren, L. I.; Gustafsson, I. (Aktiebolaget Atomenergi, Stockholm (Sweden)). Mar. 1968. 40p. Dep.

Measurements of the Doppler effect in ^{238}U capture and ^{235}U fission were made by activation technique in three different neutron spectra in the fast critical assembly FR-O. The experiments involved irradiation of thin uranium metal foils or UO$_2$ disks, which were heated in a small oven placed in the core center. The measurements on ^{238}U were extended to 1780°K and on ^{235}U to 1470°K. A core region surrounding the oven was homogenized to facilitate the interpretation of results. The reaction rates in the uranium samples were detected by gamma counting. The experimental method was checked with regard to systematic errors by irradiations in a thermal spectrum. The data obtained for ^{238}U capture were corrected for the effect of neutron collisions in the oven wall, and were extrapolated to zero sample thickness. In the softest spectrum (core 5) a Doppler effect (relative increase in capture rate) of 0.260 ± 0.018 was obtained on heating from 343 to 1780°K, and in the hardest spectrum (core 3) the corresponding value was 0.030 ± 0.003. An appreciable Doppler effect in ^{235}U fission was obtained only in the softest spectrum, in which the measured increase in fission rate on heating from 320 to 1470°K was 0.007 ± 0.003. (auth) (Sweden)

32563 (ANL-Trans–606) MULTI-PARAMETER INVESTIGATIONS OF FAST FISSION FRAGMENTS. D'yachenko, P. P.; Kuz'minov, B. D. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from pp 601-10 of STI/PUB–101, Vol. 1, Presented at Proceedings of the Symposium on Physics and Chemistry of Fission, Salzburg, March 22–26, 1965. 10p. (CONF-650301–34). Dep. CFSTI.

A number of investigators have noted the peculiar dependence of kinetic energy on the mass of the fragments. This dependence differs considerably for the fission of nuclei by thermal neutrons, neutrons with an energy of 14 MeV and α particles. It may be that this is a result of the difference not only in excitation energy, but also in the moment introduced by the particle causing fission. It is obviously difficult to deny the part played by nuclear shells in the formation of fragments according to mass, and in this connection the study of the kinetic energy of fragments as a function of their mass is of great interest, as are the corresponding investigations of the widths of distribution of the kinetic energy. Particular attention is given to the characteristics of symmetric fission of ^{235}U, and it is found that when tails appear in the apparatus spectra of the fission fragments, there occur in the symmetric mass-region pulses with a most probable total energy of ~120 MeV. Actual symmetrical fission events correspond to a total mean energy of ~155 MeV. The kinetic energy of paired fragments was measured using two surface-barrier silicon counters. The impulses are analyzed for amplitude by a two-dimensional 128 × 128 channel analyzer with a ferrite memory. The neutron source used was the BR-5 fast neutron reactor, the mean energy of the fast neutron spectrum being ~250 keV. Layers of fissile isotopes with a thickness of 20 to 30 μg/cm^2 were used. The fission of ^{235}U by thermal neutrons gave an experimental curve for the mass yield with a 250 : 1 ratio between peak and valley. Comparison of the characteristics of the fragments (kinetic energy and mass distribution) showed no noticeable difference in the fission of ^{235}U by thermal and fast neutrons. The total kinetic energy of the fragments in the symmetric fission of ^{235}U by thermal and fast neutrons proved to be identical, equalling ~155 MeV, which agrees, within the limits of experimental error, with the corresponding figures for fission of ^{235}U by neutrons with an energy of 14 MeV and of ^{232}Th by α particles. (auth)

32564 (COO-1112-165) A HIGH RESOLUTION GAMMA-RAY SPECTROSCOPIC STUDY OF THE DECAYS ^{133}Ba → ^{133}Cs AND ^{77}Ge → ^{77}As. Donnelly, Denis Philip (Michigan Univ., Ann Arbor). 1967. Contract AT(11-1)-1112. 110p. Dep. CFSTI.

Thesis.

The energy levels of ^{77}As and ^{133}Cs were investigated by high-resolution measurements of the energies and intensities of gamma rays from the beta decay of ^{77}Ge and the electron-capture decay of ^{133}Ba, respectively. A level scheme with 28 excited states and 74 transitions is proposed for ^{77}As. A decay scheme is proposed for ^{133}Ba. Spin assignments and branching ratios for a number of levels in ^{133}Cs were determined; transition multipolarities and rates were also obtained. Internal conversion coefficients for ^{133}Cs were calculated using the gamma intensities obtained and information from other sources on the conversion-electron intensities. (D.C.W.)

32565 (COO–1112-166) THE LEVEL SCHEMES OF ^{134}Ba AND ^{171}Tm. Raeside, David Edward Michigan Univ., Ann Arbor). 1968. Contract AT(11-1)-1112. 112p. Dep. CFSTI.

The gamma-ray spectra associated with the beta decay of ^{134}Cs and the beta decay ^{171}Er were studied with curved-crystal and Ge(Li) spectrometers. The data provide energy and intensity measurements of 11 gamma rays in the ^{134}Cs decay and 39 gamma rays in the ^{171}Er decay. Coincidence measurements were also made. Level schemes for ^{134}Ba and ^{171}Tm are proposed. There is no evidence for the previously proposed levels at 1570 and 1773 keV in ^{134}Ba. Two very weak gamma rays at 243 and 327 keV were measured with the curved-crystal spectrometer and were assigned to the decay of ^{134}Cs. These two transitions can be placed between well established levels in the ^{134}Ba level scheme. No evidence was found for the levels at 489 and 591 keV which other investigators have placed in the ^{171}Tm level scheme. New levels at 862 and 1285 keV are suggested for the ^{171}Tm level scheme. Three new gamma rays which can be placed between well-established levels in ^{171}Tm were measured. The existence of several transitions above 1000 keV in the decay of ^{171}Er was confirmed. 83 references. (auth)

32566 (COO-1112-167) GAMMA-RAY SPECTROSCOPY ON THE N = 82 NUCLEAR ISOTONES: ^{139}Ba, ^{140}Ce, ^{141}Pr, AND ^{142}Nd. Baer, Helmut Willy (Michigan Univ., Ann Arbor). 1967. Contract AT(11-1)-1112. 142p. Dep. CFSTI.

Thesis.

Gamma radiation from the N = 82 nuclei ^{139}La, ^{140}Ce, ^{141}Pr, and ^{142}Nd was investigated using the techniques of gamma-ray spectroscopy. Gamma-ray energies and intensities were measured with a 2-m curved-crystal spectrometer and Ge(Li) detectors. Gamma-ray decay sequences were determined by γ-γ coincidence measurements. The following results were obtained. The energy values 165.854 ± 0.012, 145.4498 ± 0.0049, and 1575.42 ± 0.39 keV were determined for the excitation energies of the first excited states in ^{139}La, ^{141}Pr, and ^{142}Nd, respectively. A total of 26 gamma-ray energies and intensities were measured in the decay of ^{140}La to levels in ^{140}Ce. A decay scheme is presented which includes 15 excited levels and 28 γ transitions. Twelve excited levels were found to be populated by β^- decay; log-ft values were determined using partial β transition probabilities and end-point energies. The multipole character of most of the γ transitions could be determined when the present data were combined with recently published conversion electron data. The spins and parities of nearly all levels in ^{140}Ce populated via the decay of ^{140}La were determined. Of particular interest are the discovery of a 5^- level at 2350.2 keV and an isomeric, 6^+ level at 2108.2 keV; they are the first states with these J^π values identified in N = 82 nuclei. A compilation and discussion of the properties of N = 82 nuclei is presented; evidence for special structure at N = 82 is reviewed. The excitation spectra are discussed in the framework of the quasiparticle description of pairing correlations in spherical nuclei. Future experiments using the techniques of radioactive decay and nuclear reactions are proposed. 79 references. (auth)

32567 (COO-1112-168) CONVERSION ELECTRON SPECTRA: A LINE SHAPE ANALYSIS FOR PERMANENT MAGNET SPECTROGRAPHS. Diethrich, Cecil Gerald (Michigan Univ., Ann Arbor). 1967. Contract AT(11-1)-1112. 121p. Dep. CFSTI.

Computer programs were written to perform a detailed analysis of the effects of variations in source width and height, slit width, source-slit-plate orientation, and radius of electron trajectories on recorded line shapes. The information obtained from the computer analysis was used in redesigning the "camera" and vacuum chamber of the spectrometer. The modified system was then used to study the internal conversion electron spectra from the decay of ^{109}Cd, ^{192}Ir, and ^{140}La. 42 references. (D.C.W.)

32568 (JINR-E4-3816) EQUILIBRIUM DEFORMATIONS OF NUCLEI IN THE RANGE 50 < Z < 82, 50 < N < 82. Arseniev, D. A.; Malov, L. A.; Pashkevich, V. V.; Sobiczewski, A.; Soloviev, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 21p. Dep.

The dependence of the energies of the ground states of even-even nuclei on beta and gamma deformations is studied in the range 50 < Z < 82, 50 < N < 82. The equilibrium deformations and their energies are calculated. It is shown that for nuclei of the region considered, the energy difference between the prolate and oblate shapes of the ellipsoid of rotation is very small, the total nuclear energy having one minimum either for $\gamma = 0°$ or for $\gamma = 60°$ (auth)

32569 (JINR-P2-3738) OPTICHESKAYA ANIZOTROPIYA IZOMEROV V OBLASTI TRANSURANOVYKH ELEMENTOV. (Optical Anisotropy in the Region of the Transuranium Elements). Baldin, A. M.; Semenko, S. F.; Tulupov, B. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 10p. (In Russian). Dep.

Some effects of the optical anisotropy of the transuranium element nuclei and their utilization for determination of the form of isomeric cross sections are discussed. (auth)

32570 (JINR-P6-3785) RAZRESHENNYI BETA-RASPAD V SFERICHESKIKH YADRAKH. (Allowed β-Decay in Spherical Nuclei). Alexander, K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1968. 21p. (In Russian). Dep.

In heavier spherical nuclei, allowed beta transitions with low log-ft values can be assumed to connect the partners of the spin-orbit splitting of shell-model levels in the proton and neutron systems, respectively. Using this rule, such transitions are analyzed in the mass region 90 ≤ A ≤ 140. The problem of what conclusions can be drawn from allowed beta decay on the two- and three-quasiparticle structure of excited states is studied. Examples of this kind are discussed for the nuclei ^{93}Mo, ^{94}Mo, ^{115}Sn, ^{116}Sn, ^{118}Sn, ^{120}Sn, ^{138}Ce, and ^{140}Pm. (auth)

32571 (KFKI-11/1968) g-FACTOR OF THE 656 keV STATE IN ^{110}Cd. Keszthelyi, L.; Demeter, I.; Dezsi, I.; Varga, L. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). Apr. 22, 1968. 3p. Dep.

The g-factor of the first 2^+ excited state of ^{110}Cd was measured by observing angular correlations of the 1504-656 keV and the 1384/885/-656 keV cascades simultaneously. The internal magnetic field method was used; ^{110m}Ag was diffused into an Fe lattice. (D.C.W.)

32572 (MIT-2098-422) PHYSICS PROGRESS REPORT, OCTOBER 1, 1966–OCTOBER 1, 1967. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). Oct. 1, 1967. Contracts AT(30-1)-2098; AF19(628)-2389; NASw-37; NASA-2053; NAS5-3205. 49p. Dep. CFSTI.

Separate abstracts were prepared for the eight sections of the report. (D.C.W.)

For abstracts of individual sections see: 30856, 31661, 32040, 32074, 32365, 32516, 32573, and 32574.

32573 (MIT-2098-422, pp 69-94) RADIOACTIVITY GROUP. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science).

Measurements of the magnetic moments of nuclear excited states and of internal magnetic fields at nuclei in metals were measured using ion implantation with Coulomb excitation. The charge exchange and stopping power of heavy ions in foils and gases were investigated. G-factors for short-lived states in ^{152}Gd, ^{208}Pb, and ^{192}Os were measured by observing perturbed γ-γ angular correlations in the internal magnetic fields at impurity sites in Fe. The isomer shift of the first excited state in ^{153}Eu was measured, and Moessbauer studies of the quadrupole moments of W isotopes were initiated. The internal magnetic field distribution in type-II superconducting Nb was studied by observing the time-dependent perturbed angular correlation of the 75–84 keV γ-γ cascade in ^{100}Rh. Preliminary results were obtained in a program of measurements of total internal conversion coefficients in some heavy even-even nuclides. (D.C.W.)

32574 (MIT-2098-422, pp 95-105) CYCLOTRON GROUP. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science).

Preliminary results of an investigation of the energy levels of ^{118}Sn by alpha inelastic scattering; of the reactions ^{39}K(α,d) and (α,t); and of the reactions ^{208}Pb(p,d)^{207}Pb and ^{208}Pb(p,t)^{206}Pb are presented. Progress in the production of Ge(Li) gamma detectors is also summarized. Most of the research performed during the period has already appeared in print or has been prepared for publication. (D.C.W.)

32575 (NAA-SR-Memo-12487) ^{155}Gd CROSS SECTION ANALYSIS FOR INTRINSIC SUBCRITICALITY STUDIES. Ottewitte, E. H. (Atomics International, Canoga Park, Calif.). May 31, 1967. 23p. Dep. CFSTI.

The analysis showed that scattering cross section components can be ignored and that absorption resonance effects are generally small. (auth)

32576 (ORO-3638-2) KINETIC ENERGY SPECTRA OF FOIL TRANSMITTED FISSION FRAGMENTS OF ^{252}Cf. Bucy, Shawn (Murray State Univ., Ky.). May 1968. Contract AT(40-1)-3638. 30p. Dep. CFSTI.

A mathematical model for the calculation of kinetic energy spectra of fragments from the spontaneous fission of ^{252}Cf has been developed. This model predicts the spectra of these fragments after transmission through any absorber whose thickness and composition are known. The model may be applied to other fissioning elements with minor modifications. Agreement between calculated and experimentally observed peak positions typically agree to within 5%. The energy shifts due to an absorber may be calculated to within 25%. (auth)

32577 (TID-24373(Pt.1)) DETAILED STUDY OF THE RADIOACTIVE DECAY KINETICS OF ^{238}Pu AND RELATED PARENT AND DAUGHTER NUCLIDES. PART I. HELIUM GENERATION, THERMAL POWER, AND SPONTANEOUS FISSION. Garber, Harold J. (Nuclear Materials and Equipment Corp., Apollo, Pa. Energy Conversion Div.). June 8, 1967. Contract AT(30-1)-3731. 75p. Dep. CFSTI.

A complete study of the radioactive decay kinetics of the seven parent nuclides present in Savannah River Laboratory ^{238}Pu isotopic power fuel was conducted. The kinetics survival equations for ^{236}Pu, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{242}Pu, and ^{237}Np, their 104 daughters, and helium generation were developed, with the constants rounded off to 12 significant figures, starting with one mole of parent nuclide in each case. For making the calculations the radiochemical and nuclear physics values included in Dzhelepov and Peker's treatise were used. The kinetics equations were then used to develop radioactive decay kinetics values up to 2,000 years of time lapse subsequent to nuclide processing and fuel fabrication. These data are assembled in tabular form in a generalized fashion so that the results can be readily applied to a calculation of the instantaneous cumulative helium and specific thermal power for any ^{238}Pu type fuel whose initial assay and analysis is known. For immediate cardiac pacemaker design purposes, the helium buildup and specific thermal power are presented in tabular and chart form for SRP "Typical" ^{238}Pu product having an analysis of 0.00012% ^{236}Pu, 80.5% ^{238}Pu, 14.9% ^{239}Pu, 2.9% ^{240}Pu, 0.8% ^{241}Pu, 0.1% ^{242}Pu, and 0.5% ^{237}Np. Also included in the report are tabulations for the kinetics of spontaneous fissioning for ^{238}Pu and related nuclides and a number of auxiliary computational aids useful in making design calculations. The applicability of the kinetics information to serve as a springboard from which to conduct a detailed study of the radiological properties of the pacemaker is indicated. (auth)

32578 (TID–24373(Pt.2)) DETAILED STUDY OF THE RADIOACTIVE DECAY KINETICS OF ^{238}Pu AND RELATED PARENT AND DAUGHTER NUCLIDES. PART II. DESCRIPTION OF A LONG LIFE RADIOISOTOPIC FUEL WITH FLAT POWER GENERATION CHARACTERISTICS. Garber, Harold J. (Nuclear Materials and Equipment Corp., Apollo, Pa. Energy Conversion Div.). June 8, 1967. Contract AT(30-1)-3731. 38p. Dep. CFSTI.

The properties of blended ^{238}Pu–^{241}Pu isotopic fuels are discussed, and it is shown that optimum power flattening is achieved at the 35% ^{238}Pu-65% ^{241}Pu composition. The merits of such a fuel in connection with fueling long life medical appliances, including the cardiac pacemaker are demonstrated. Brief mention is also made of the potential application of such a fuel to other RTG devices requiring extended mission periods. (auth)

32579 (TID–24500) THE INDEPENDENT YIELD OF ^{112}Ag AND THE CUMULATIVE YIELD OF ^{115}Pd IN THERMAL-NEUTRON INDUCED ^{233}U AND ^{235}U FISSION. Roche, Michael Francis (Oak Ridge Associated Universities, Inc., Tenn. Oak Ridge National Lab., Tenn.). Jan. 1968. 99p. Dep. CFSTI.

Thesis. Submitted to Saint Louis Univ., Mo.

The independent yield of ^{112}Ag and the cumulative yield of ^{115}Pd were measured for thermal neutron-induced fission of both ^{233}U and ^{235}U by using timed, palladium-dimethylglyoxime precipitations to separate silver and palladium activities. The ^{112}Ag was counted on an anthracene detector to allow energy discrimination against the interfering ^{111}Ag, ^{113}Ag, and ^{115}Ag activities; and the ^{115}Pd yield was deduced from the activities of both ^{115}Cd isomers to which it decays. From this study, the fractional independent yield of ^{112}Ag was $6 \pm 3 \times 10^{-5}$ and $27 \pm 4 \times 10^{-5}$; the fractional cumulative yield of ^{115}Pd was 0.89 ± 0.01 and 0.67 ± 0.02 for ^{235}U and ^{233}U, respectively. The yields implied that the most probable nuclear charge in symmetric fission is that corresponding to maximum energy release, half the nuclear charge of the compound nucleus. (auth)

32580 (UCRL–71049) BAND PROPERTIES OF EVEN-EVEN NUCLEI WITH SMALL DEFORMATIONS. Meyer, R. A. (California Univ., Livermore. Lawrence Radiation Lab.). Apr. 29, 1968. Contract W-7405-eng-48. 28p. (CONF-680702-1). Dep. CFSTI.

From International Symposium on Nuclear Structure, Dubna, USSR.

The gamma-ray spectra from the decay of ^{154}Eu, ^{154}Tb, and ^{154}Tb^{m} have been measured with a maximum energy precision of 40 eV and maximum relative intensity precision of 1% for the more intense gamma rays. Use of a Compton suppression spectrometer allowed detection of low-energy gamma rays with a relative intensity of a few parts in 10^6 decays. In addition, coincidence experiments were performed (Ge(Li) spectra gated by signals from a NaI crystal). An attempt was made to describe the level properties of ^{154}Gd obtained from the deduced decay schemes by the Bohr-Mottelson deformed model and its modifications. It is found that the band-mixing parameter, z_K, is a poor quantity for this nucleus, and its use for this nucleus in the past may be the cause of a number of discrepancies. Several levels found in this nucleus fit the criteria of forming second vibrational (two-phonon) states. A band which fits the description of a $\beta\gamma$-coupled second vibrational band has been observed. The possibility of at least one member of a $\beta\beta$-coupled second vibrational level is also considered. The predictions of Soloviev for the negative-parity bands are found to agree with those observed in this nucleus. The proposed members of the K = 0, 1 and 2 bands indicate the presence of collective Coriolis-type forces acting between the K = 0 and K = 1 bands as well as a more two-quasiparticle (p-RPC) type between the K = 1 and K = 2 bands. Recent results on several other nuclei are also discussed. (auth)

32581 (USNRDL-TR–68-35) THERMAL-NEUTRON FISSION OF ^{235}U: IDENTIFICATION AND FRACTIONAL CHAIN YIELD OF ^{77}Ga. Wish, L. (Naval Radiological Defense Lab., San Francisco, Calif.). Feb. 11, 1968. Contract AT(49-2)-1167. 31p. Dep. CFSTI.

The study of nuclear charge dispersion in the light-fission-product region from thermal-neutron irradiation of ^{235}U was begun with measurements on mass chain 77. An ion exchange procedure was developed which rapidly separated Ga from its daughter products, Ge and As. Ga separations were made at various times after fission and the Ge daughter activities were isolated and measured. From these activities ^{77}Ga and ^{78}Ga were indirectly identified as fission products. The half-life of ^{77}Ga was determined to be 17.1 ± 1.5 sec and that of ^{78}Ga was estimated to be about 4 sec. The branching ratio of ^{77}Ga for formation of ^{77m}Ge and ^{77g}Ge was obtained from measurements of the 39-hr ^{77}As activity at the time when the 54-sec ^{77m}Ge and the 11.3-hr ^{77g}Ge had each mostly decayed. Values obtained for decay to ^{77m}Ge and ^{77g}Ge are 0.88 ± 0.02 and 0.12 ± 0.02, respectively. The fractional cumulative yield of ^{77}Ga was determined as 57.3 ± 1.4 percent. (auth)

32582 COINCIDENCE TECHNIQUES USED TO DETERMINE ABSOLUTE DISINTEGRATION RATE OF A FINITE ^{198}Au SAMPLE. Dooley, John A. (Wright Patterson Air Force Base, Ohio). Trans. Amer. Nucl. Soc., 11: 71-2(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32583 STUDY OF THE LEVEL SCHEME OF ^{217}At. Leang, Chin-fan; Bastin-Scoffier, Genevieve (CNRS, Orsay, France). Compt. Rend., Ser. A and B, 266: 629-32(Mar. 4, 1968). (In French).

The levels of ^{217}At were determined by α magnetic spectrography of ^{221}Fr, and the γ transitions were determined by bidimensional coincidences between an α junction and a γ Ge(Li) detector. An α-γ angular correlation was measured for the transition at 218 keV. (tr-auth)

32584 NEUTRON YIELDS FROM HEAVY ISOTOPES BOMBARDED BY ELECTRONS. Groce, D. E. (Gulf General Atomic Inc., San Diego, Calif.); Alter, C. P.; Herring, D. F. Trans. Amer. Nucl. Soc., 11: 179–80(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32585 THE THERMAL-NEUTRON ACTIVATION CROSS SECTIONS AND RESONANCE INTEGRALS FOR ^{128}Te(n,γ)^{129g}Te AND ^{128}Te(n,γ)^{129m}Te REACTIONS. Maxia, Vera; Orvini, Edoardo; Rollier, Mario A. (Univ. of Pavia, Italy). Trans. Amer. Nucl. Soc., 11: 70(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32586 MONTE CARLO ANALYSIS OF GOLD SHELL TRANSMISSION EXPERIMENTS AT 24 keV USING SPIN-DEPENDENT STATISTICAL DATA. Semler, Thor T. (Lewis Research Center, Cleveland). Trans. Amer. Nucl. Soc., 11: 162(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32587 DOPPLER EFFECT IN ^{238}U AT INTERMEDIATE S/M VALUES. Sher, R.; Whitesel, R. N. (Stanford Univ., Calif.). Trans. Amer. Nucl. Soc., 11: 184-5(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32588 STUDIES OF UNRESOLVED RESONANCES WITH A 2-keV NEUTRON BEAM. Simpson, O. D.; Miller, L. G. (Idaho Nuclear Corp., Idaho Falls). Trans. Amer. Nucl. Soc., 11: 298-300(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32589 AN INVESTIGATION OF ^{239}Pu ALPHA IN THE keV ENERGY RANGE THROUGH SOME LATTICE EXPERIMENTS. Sehgal, Bal Raj; Price, Glenn A.; Windsor, Henry H. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc., 11: 202-3(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32590 EVALUATION OF ETA FOR ^{233}U AT 0.025 eV USING THE RECAP 4C MONTE CARLO PROGRAM. Emert, C. J.; Milani, S.; Candelore, N. R. (Bettis Atomic Power Lab., West Mifflin, Pa.). Trans. Amer. Nucl. Soc., 11: 165-6(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32591 MEASUREMENT OF ABSOLUTE DELAYED-NEUTRON YIELDS FROM 14-MeV FISSION. Masters, C. F.; Thorpe, M. M.; Smith, D. B. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc., 11: 179(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32592 RADIATIVE CAPTURE OF NEUTRONS BY NUCLEI WITH A = 140 TO 200. Konks, V. A.; Popov, Yu. P.; Fenin, Yu. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 7: 493-9(Mar. 1968). (In Russian).

Using the neutron slowing down time in the Pb spectrometer, the dependence of cross sections of radiative capture of neutrons with energies up to 50 keV by the nuclei Eu, ^{153}Eu, ^{165}Ho and Lu is measured. Analyzing the energy dependence on the averaged cross section of capture, the values of strength functions for s- and p-neutrons, the values Γ_γ/D for ^{151}Eu, ^{153}Eu, ^{165}Ho and Lu are obtained as well as the upper estimation for the strength functions of d-neutrons for La and Pr. (auth)

32593 ASYMMETRY OF THE ^{238}U PHOTOFISSION NEAR THRESHOLD. Kurchatov, B. V.; Novgorodtseva, V. I.; Pchelin, V. A.; Smirenkin, G. N.; Tsipenyuk, Yu. M.; Shubko, V. M. (Inst. of Physical Problems, Moscow). Yadern. Fiz., 7: 521-7(Mar. 1968). (In Russian).

Yields of fragments ^{115,117}Cd, ^{111}Ag, ^{99}Mo, and ^{139,140}Ba from the ^{238}U photofission are measured in the underbarrier region in the range of the bremsstrahlung spectrum limiting energies $E_{max} = 4.5$ to 6.5 MeV. It is shown that the relative probability of the symmetric fission does not depend monotonously on the excitation energy. There is a maximum at $E_\gamma = 6.0$ MeV; with E_γ decreasing it falls by 30 to 40 times, then increases again and has a "cusp" at $E_\gamma \approx 5.3$ MeV. The question of interpretation of the experimental data is open. (auth)

32594 INVESTIGATION OF ANGULAR DISTRIBUTION OF α-PARTICLES FROM ALIGNED ^{233}U NUCLEI AT SUPER LOW TEMPERATURE. Matvienko, V. I.; Kogan, A. V.; Petrzhak, K. A. Yadern. Fiz., 7: 473-7(Mar. 1968). (In Russian).

The spatial distribution of α particles from ^{233}U nuclei oriented in the lattice of uranyl-rubidium nitrate at very low temperature, is investigated. The total angular distribution up to 0.05°K and the temperature dependence of the anisotropy coefficient are determined. This dependence is not in agreement with the expected result, if one assumes that the spin Hamiltonian of the uranyl complex contains the quadrupole term only. Possible explanations of this disagreement are presented. (auth)

32595 STUDY OF THE DECAY OF ^{119}I. Sergolle, Henri (Institut de Physique Nucleare, Orsay, France). Compt. Rend., Ser. A and B, 266: 633-5(Mar. 4, 1968). (In French).

The study of γ rays associated with the decay by β^+ emission and by electron capture of ^{119}I leads to the proposal of a partial level scheme of ^{119}Te. (tr-auth)

32596 NEUTRON CAPTURE BETWEEN 5 keV AND 3 MeV. Stupegia, D. C.; Schmidt, Marcia; Reedy, C. R.; Madson, A. A. (Argonne National Lab., Ill.). J. Nucl. Energy, 22: 267-81(May 1968).

Neutron capture cross sections were measured as a function of neutron energy between about 5 keV and 3 MeV for ^{41}K, ^{55}Mn, ^{85}Rb, ^{89}Y, ^{98}Mo, ^{139}La, ^{141}Pr, ^{158}Gd, ^{170}Er, ^{175}Lu and ^{176}Yb, using the activation method. The data were compared with calculations based upon the statistical compound model of nuclear reactions. For nuclei which are not deformed, the correct shapes of the cross-section curves can be predicted from a few keV up to the energy at which the target levels are known. Predicting the absolute values depends sensitively upon the choice of Γ_γ/D_{obs}, for which parameter accurate values are not always available. For the deformed nuclei, statistical theory in combination with the spherical optical model does not correctly predict the shapes. (auth)

32597 RESONANCE PARAMETERS OF ^{240}Pu. PART I. NEUTRON WIDTHS. Kolar, W.; Boeckhoff, K. H. (EURATOM, Geel, Belg.). J. Nucl. Energy, 22: 299-315(May 1968).

The neutron total cross section of ^{240}Pu was measured with high resolution in the energy range 20 eV to 5.7 keV. Up to this energy, 264 resonances were detected and analyzed with respect to Γ_n using the area program of Atta and Harvey. For 32 resonances between 38 and 820 eV, the full set of resonance parameters E_r, Γ_n and Γ_γ could be evaluated by combining the results of the transmission experiment with those of the capture experiment described in Part II. For the 102 resonances up to 1500 eV, a mean level spacing of $\langle D \rangle = 14.7 \pm 0.8$ eV was obtained. On the assumption that all resonances in that range are of the s-type, the strength function yields $S_0 = 1.05 \pm 0.16 \times 10^{-4}$. (auth)

32598 RESONANCE PARAMETERS OF ^{240}Pu. PART II. RADIATIVE WIDTHS. Weigmann, H.; Schmid, H. (EURATOM, Geel, Belg.). J. Nucl. Energy, 22: 317-20(May 1968).

Neutron radiative capture in ^{240}Pu was studied in the neutron energy range from 38 to 820 eV. An area analysis was applied to the resonances observed. By combining the results of this analysis with those of the total cross-section measurements performed, the radiative widths of 32 resonances were determined, yielding a mean value of $\langle \Gamma_\gamma \rangle = 23.2 \pm 2.0$ MeV. The observation of unusually large radiative widths for some resonances is explained by the presence of sub-threshold fission; this effect is discussed in detail. (auth) (UK)

32599 NEUTRON RESONANCE PARAMETERS OF Sb. Mateiciuc, V.; Aldea, L.; Constantinescu, M.; Cristea, Gh.; Stadnicov, T. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys., 12: 907-16(1967). (In Rumanian).

The neutron effective total cross sections of Sb was measured between 0.05 and 3 eV, and the parameters of resonances at 6.24, 15.5, and 29.7 eV in ^{121}Sb and at 21.6 eV in ^{123}Sb are given. The experimental values obtained for the parameters are in good agreement with theory. (tr-auth)

32600 PROPERTIES OF THE 321 keV $^9/_2{}^-$ LEVEL IN ^{125}Te. Kownacki, J.; Ludziejewski, J.; Moszynski, M. (Inst. of Nuclear Research, Swierk, Poland). Nucl. Phys., A113: 561-3(1968). (INR-P-865/IA/PL).

The half-life of the 321-keV $^9/_2{}^-$ level in ^{125}Te was determined with a time-to-amplitude converter to be 0.695 ± 0.015 ns. The half-life limits of some higher-lying states were established. The effect of the three-quasiparticle nature of the 321-keV level on the probability of the 176-keV γ-transition de-exciting this level is discussed. (auth)

32601 TWO-NUCLEON TRANSFER REACTIONS WITH LEAD ISOTOPES. Riedel, C. (Central Inst. for Nuclear Research, Rossendorf, Ger.); Broglia, R. A.; Miranda, A. Nucl. Phys., A113: 503-20(1968).

The reactions ^{207}Pb(t, p)^{209}Pb, ^{208}Pb(t, p)^{210}Pb, and ^{207}Pb(p,t)^{205}Pb were analyzed using shell-model wave functions. Calculated angular distributions and relative cross sections are in good agreement with experimental data. Theoretical spectroscopic factors are given for the reactions ^{206}Pb(d, t)^{205}Pb and ^{204}Pb(d, p)^{205}Pb. (auth)

32602 PRECISION MEASUREMENT OF THE ENERGIES OF THE GAMMA RAYS FROM ^{144}Nd. Sayres, A. R.; Trail, C. C. (City Univ. of New York, Brooklyn). Nucl. Phys., A113: 521-8(1968).

The energies of the two cascade gamma rays emitted by ^{144}Nd following β decay of ^{144}Pr were measured to be 1489.14 ± 0.07 keV and 696.48 ± 0.09 keV. The energy of the cross-over gamma ray is found to be 2185.72 ± 0.05 keV in agreement with that expected from the sum of the energies of the cascade gamma rays. The ratio of the intensities of the 696, 1489, and 2186 keV gamma rays are found to be $100 : 17.7 \pm 0.5 : 48 \pm 9$. (auth)

32603 NOTE ON THE DECAY OF THE 115 μs ISOMER IN ^{159}Dy. Borggreen, J.; Gjaldbaek, J. P. (Univ. of Copenhagen). Nucl. Phys., A113: 659-64(1968).

The 115-μs isomer in ^{159}Dy was studied by e-γ and γ-γ coincidence techniques with the use of a Ge(Li) detector and a magnetic electron spectrometer. A decay scheme of the isomer is proposed, which maintains the $^{11}/_2$[505] assignment to the isomeric level. (auth)

32604 THE DECAY OF ^{142}Pr TO ^{142}Ce AND ^{142}Nd. Raman, Subramanian (Oak Ridge National Lab., Tenn.). Nucl. Phys., A113: 603-7(1968).

The γ rays from ^{142}Pr were studied with a 30 cm^3 Ge(Li) detector both directly and in coincidence with a 1576 ± 60-keV gate selected with a NaI(Tl) scintillation detector. The ^{142}Pr ground state was observed to decay to the 642-keV (2^+) level in ^{142}Ce and the 2084.4-keV (3^-) level in ^{142}Nd in addition to the previously known decay to the 1575.6-keV level in ^{142}Nd. (auth)

32605 SOME NEW FEATURES IN THE DECAY OF ^{142}Pr. Hill, John C.; Wiedenbeck, M. L. (Univ. of Michigan, Ann Arbor). Nucl. Phys., A113: 598-602(1968).

The ^{142}Pr → ^{142}Nd decay was investigated, and a new gamma ray at 508 keV was found depopulating a level at 2084 keV. On the basis of energy, intensity, and coincidence measurements using a Ge(Li) detector, a new decay scheme is proposed. The new level is probably identical to a 3^- level seen in reaction studies. (auth)

32606 DECAY OF ^{121m}Sn AND ^{121}Sn. Snyder, R. E.; Beard, G. B. (Wayne State Univ., Detroit). Nucl. Phys., A113: 581-92(1968).

The decay schemes of ^{121}Sn and ^{121m}Sn were investigated with a 4π beta spectrometer and β-γ coincidence techniques. The beta spectrum of ^{121m}Sn has an end-point energy of 354 ± 5 keV and yields a linear Fermi–Kurie plot when a first-forbidden unique shape factor is applied. The ^{121}Sn half-life was found to be 25.5 ± 0.1 h, and the beta spectrum had an end-point energy of 383 ± 3 keV. From the beta spectra and the ^{121}Sb level structure, the

^{121}Sn level was found to be 8 ± 5 keV above the ^{121}Sn ground state. The spin and parity assignments for the ^{121}Sn and ^{121m}Sn states are in agreement with the shell model. The 37-keV ^{121}Sb transition which follows the decay of ^{121m}Sn was investigated by using a Li-drifted silicon detector. A γ-ray energy of $37.15^{+0.04}_{-0.02}$ keV and a K internal-conversion coefficient of $\alpha_K = 9.32 \pm 0.37$ were obtained. (auth)

32607 SHORT-RANGE INTERMEDIATE STRUCTURE OBSERVED IN THE ^{237}Np NEUTRON SUBTHRESHOLD FISSION CROSS SECTION. Fubini, A.; Blons, J.; Michaudon, A.; Paya, D. (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). Phys. Rev. Lett., 20: 1373-5(June 10, 1968).

The interaction of resonance neutrons with ^{237}Np was investigated in order to obtain more information on the fission barrier and the mechanism of subthreshold fission induced by slow neutrons. The fission and total cross sections were measured up to about 4 keV. The total cross section is very similar to those of other odd-A nuclei with mass numbers near 237; individual resonances up to 230 eV were analyzed using standard methods. The fission cross section differs radically from the total cross section and from the fission cross sections of other nuclei; it is composed of high peaks at definite energies. The experimental fission cross section was compared with a "simulated" cross section, which was calculated from a set of parameters selected at random but obeying the usual statistical distributions. The comparison confirmed the presence of an intermediate structure in the neutron subthreshold fission cross section of ^{237}Np. The intermediate structure presents a minimum at zero neutron energy. (D.C.W.)

32608 LEVEL AND ISOMER SYSTEMATICS IN EVEN Sn ISOTOPES. Yamazaki, T.; Ewan, G. T.; Prussin, S. G. (Univ. of California, Berkeley). Phys. Rev. Lett., 20: 1376-8(June 10, 1968).

Isomeric states in even Sn isotopes were investigated using nanosecond time analysis of γ rays from Cd(α,xn) reactions. The existence of new isomers in A = 112 to 118, in addition to the known negative-parity isomers in ^{116}Sn, ^{118}Sn, and ^{120}Sn, was observed. The energies of these newly observed levels appear to vary systematically with A. Theoretical considerations indicate that the newly observed isomers from A = 114 to 118 may arise from an $(h_{11/2})^2$ neutron configuration. (D.C.W.)

32609 MIXING RATIO OF THE M1 AND E2 RADIATIONS IN THE $2^+ \rightarrow 2_1^+$ TRANSITIONS IN ^{200}Hg. Futami, Yasuhiko; Sakai, Mitsuo (Tokyo Univ. of Education. Tokyo Univ.). Prog. Theor. Phys. (Kyoto), 39: 233-4(Jan. 1968).

The configuration of the two-quasiparticle $2'^+$ state at 1575 keV is investigated on the basis of the mixing ratio for the $2'^+ \rightarrow 2_1^+$ transition. (D.C.W.)

32610 NUCLEAR ISOMERS WITH HALF-LIVES IN THE 30 TO 3000 μs RANGE, EXCITED IN 24-MeV ALPHA-PARTICLE BOMBARDMENTS ON NATURAL TARGETS. Ivanov, E. A. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys., 12: 829-38(1967).

About 50 elements of natural isotopic abundances were irradiated with a pulsed 24-MeV alpha-particle beam; and 14 short-lived isomers with half-lives ranging from 30 to 3000 μs were observed. Isomers not reported so far in the literature were obtained from the following targets: Br: 150 μs, 156 and 80 keV; Zr: 420 μs, 164 and 84 keV; Mo: 57 μs, 1400, 780, 148, and 77 keV; In: 440 μs, 200, 76, and 27 keV; Sm: 92 μs, 80 and 46 keV; Gd: 125 μs, 180, 116, 82, and 48 keV; and Ta: 235 μs, 208, 156, and 64 keV plus a complex spectrum. (auth)

32611 THE MAGNETIC HYPERFINE INTERACTION IN MUONIC ^{209}Bi. Johnson, J.; Sorensen, R. A. (Carnegie-Mellon Univ., Pittsburgh). Contract Nonr 760(15); NR 024-439. Phys. Lett., 26B: 700-2(May 13, 1968).

The hyperfine structure for muonic ^{209}Bi is calculated for several models of distribution of nuclear magnetism and compared to experiment. (auth)

32612 ENHANCED $d_{5/2}$ DECAY OF THE ANALOGUE RESONANCE OF THE ^{107}Cd GROUND STATE TO THE FIRST EXCITED STATE OF ^{106}Cd. Abramson, E.; Plesser, I.; Vager, Z. (Weizmann Inst. of Science, Rehovot, Israel). Phys. Lett., 26B: 723-6(May 13, 1968).

Three analogue resonances of ^{107}Cd states have been observed by (p,p) and (p,p') scattering. Two of them have large spectroscopic factors for decay to the 2^+ first excited state of ^{106}Cd but small factors for decay to the 0^+ ground state. A study of the angular distribution of γ rays following the inelastic process is presented. (auth)

32613 THE REACTIONS ^{207,208}Pb(t,p)^{209,210}Pb AND THE TWO-PARTICLE-ONE-HOLE STATES OF ^{209}Pb. Bjerregaard, J. H.; Hansen, Ole; Nathan, O.; Vistisen, L. (Univ. of Copenhagen). Nucl. Phys., A113: 484-502(1968).

The reactions ^{207,208}Pb(t, p)^{209,210}Pb were investigated at 13-MeV bombarding energy. In ^{210}Pb, a total of 35 levels was excited below E_x = 4.7 MeV, and in ^{209}Pb a total of 31 levels was identified below E_x = 4.6 MeV. In the latter nucleus, all of the seven single-neutron states were observed. States at 2.16, 2.74, 2.87, and 2.91 MeV are identified as two-particle-one-hole states of ^{209}Pb. The transition to the 2.16-MeV level has L = 0, whereas the three latter transitions have L = 2. (auth)

32614 COULOMB EXCITATION OF EVEN Sm ISOTOPES. Keddy, R. J.; Yoshizawa, Y.; Elbek, B.; Herskind, B.; Olesen, M. C. (Univ. of Copenhagen). Nucl. Phys., A113: 676-88(1968).

Low-lying excited states in ^{148}Sm, ^{150}Sm, and ^{154}Sm were studied by means of Coulomb excitation with oxygen ions. Gamma rays from thin metallic targets were detected in coincidence with backscattered oxygen ions in NaI(Tl) crystals. In the case of ^{148}Sm and ^{150}Sm singles, gamma-ray spectra were also recorded by means of a Li-Ge detector. Gamma rays originating from the states at 0.551 MeV (2^+), 1.162 MeV (3^-), 1.181 MeV (4^+), and 1.455 MeV (2^+) were observed in the ^{148}Sm spectra and from the states at 0.334 MeV (2^+), 0.741 MeV ($0^{+\prime}$), 0.774 MeV (4^+), 1.046 MeV ($2^{+\prime\prime}$), 1.072 MeV (3^-), and 1.193 MeV ($2^{+\prime}$) in the ^{150}Sm spectra. The B(E2) values between several of the positive-parity states were derived from first- and second-order perturbation theory. The B(E3) values obtained for the 3^- states were 0.37 ± 0.03 and 0.31 ± 0.03 $e^2 \times 10^{-72}$ cm^6 for ^{148}Sm and ^{150}Sm, respectively. For the lowest octupole bands in ^{152}Sm and ^{154}Sm, the B(E3) values were 0.14 ± 0.03 and 0.11 ± 0.03 $e^2 \times 10^{-72}$ cm^6, respectively. (auth)

32615 COULOMB EXCITATION OF STATES IN THE EVEN-MASS RUTHENIUM NUCLEI WITH ^{16}O AND ^{4}He IONS. McGowan, F. K.; Robinson, R. L.; Stelson, P. H.; Milner, W. T. (Oak Ridge National Lab., Tenn.). Nucl. Phys., A113: 529-42(1968).

Ions of ^{16}O with energies of 42 to 49 MeV and 10-MeV ^{4}He ions were used to excite states in ^{98,100,102,104}Ru. The second $2'^+$ and 4^+ states in ^{104}Ru, ^{102}Ru, and ^{98}Ru are nearly degenerate. The cascade γ-rays from the decay of the $2'^+$ and 4^+ states to the first 2^+ state have energies of 535.4 and 530.6 keV in ^{104}Ru and 628.1 and 631.6 keV in ^{102}Ru. The values obtained for the ratio B(E2, $4 \rightarrow 2$)/B(E2, $2 \rightarrow 0$) are 1.27 ± 0.14, 1.37 ± 0.27, and 1.17 ± 0.22 for ^{100}Ru, ^{102}Ru, and ^{104}Ru, respectively. For ^{104}Ru, the branching ratio of cascade to cross-over transitions from the decay of the $2'^+$ state is 1.7 ± 0.2, and the ratio B(E2, $2' \rightarrow 2$)/B(E2, $2 \rightarrow 0$) is 0.66 ± 0.11. The angular distribution of the γ-rays from the $2' \rightarrow 2$ transition in ^{104}Ru was obtained with an accuracy sufficient to establish the magnitude and sign of δ. The value obtained for $\delta \equiv \langle 2 \| \mathscr{M}(E2) \| 2' \rangle / \langle 2 \| \mathscr{M}(M1) \| 2' \rangle$ is $-(8.5^{+2.5}_{-1.5})$. The B(M1, $2' \rightarrow 2$) for ^{104}Ru is $(3.4^{+1.5}_{-1.3}) \times 10^{-4}$ in units of $(e\hbar/2Mc)^2$. A state at 983 keV in ^{104}Ru is interpreted to be the result of double E2 excitation of a 0^+ excited state. The E2 transition between the excited $0'^+$ state and the first 2^+ state is 5.0 ± 0.6 times smaller than the vibrational-model prediction. (auth)

32616 NEUTRON CROSS-SECTION MEASUREMENTS ON RADIOACTIVE NUCLIDES USING NEUTRONS FROM AN UNDERGROUND NUCLEAR EXPLOSION. Brown, W. K.; Diven, B. C.; Seeger, P. A. Ark. Fys., 36: 47-55(1967).

The method developed at the Los Alamos Scientific Laboratory of using time-of-flight techniques in combination with a neutron burst from the underground detonation of a nuclear explosive has opened new possibilities in neutron cross-section measurement. The enormously high neutron flux generated in such a burst can be used to give correspondingly large reaction rates in targets. An obvious exploitation of this circumstance lies in the measurement of the cross sections of radioactive nuclides. Such measurements are often impossible using conventional neutron sources due to the high radioactive background, the rapid disappearance of the target, or both. With large reaction rates, the radioactive background becomes relatively small, and the amount of sample does not change significantly in the several milliseconds during the measurement. Having demonstrated the efficacy of the method in general on the "Petrel" event in June, 1965 at the Nevada Test Site, efforts are turning specifically to measurements of the cross sections of radioactive isotopes.
It is planned to measure the capture cross section of ^{147}Pm (2.7 y), a fission product from which, through neutron capture, the reactor poison ^{148}Pm is synthesized. Plans for future measurements include the capture cross section of ^{148}Pm (41 d), ^{233}Pa (27.4 d), and possibly the fission cross section of ^{235m}U (26.2 m) which would require fast chemistry under field conditions. It is intended to push toward measurements on nuclides increasingly further from the stability line. These measurements will provide basic nuclear structure information not otherwise presently obtainable. Measurement of these cross sections will strengthen knowledge

of the systematics among radioactive nuclides and lower the uncertainties in the extrapolation necessary for the analysis of r-process nucleosynthesis. (auth)

32617 LIVERMORE PROGRAM FOR SEPARATING AND STUDYING THE PRIMARY FISSION FRAGMENTS. Stevenson, P. C.; Cambey, L. A.; Smith, T. Ark. Fys., 36: 279-85(1967).

The Lawrence Radiation Laboratory at Livermore is supporting a program to develop a generally applicable technique for studying in detail the primary products of fission. Measurements of the half-lives, decay schemes, isobaric chain yields, and average kinetic energies of the primary fission fragments over the entire mass range of fission products are to be made. The technique consists of stopping fission fragments in mixtures of highly purified noble gases; transporting the stopped ions (which are still ionized) out of the reactor; passing them through a differential pumping system into a satisfactory vacuum; reaccelerating and mass-separating them; and finally studying their yields and decay characteristics by suitable detectors. Information on kinetic energy of a particular isobar is derived from studying the variation of yield with fission source thickness, which gives the range of the fragment in the source material. Information on the chemical nature of the fragments can be deduced from the variation of ionic charge with noble gas mixture, since the ionic charge of the thermalized fragment will depend on the first ionization potential of the most easily ionized gas present. Times from formation of fission fragments to arrival at the detector are predicted to be of the order of a few tens of milliseconds. Equilibrium arrival rates at the detector are estimated to be large enough such that fission products over the mass range from about 75 to about 160 (for ^{235}U) may be investigated. (auth)

32618 BETA DECAY OF SOME CERIUM ISOTOPES FAR TO THE NEUTRON-RICH SIDE OF STABILITY. Hoffman, D. C.; Michelsen, O. B.; Daniels, W. R. Ark. Fys., 36: 211-20(1967).

A procedure involving column partition chromatography was used to achieve very rapid separation of fission product Ce. This technique permitted the direct observation of the decay of 1.2 min ^{147}Ce and 3.0 min ^{145}Ce without interference from the growth of Pr daughter activities. Mass-free sources of ^{146}Ce were also prepared for observations of its electron spectrum. A direct measurement of the half-life of ^{147}Ce gave 1.2 ± 0.1 min in agreement with the value of 1.1 ± 0.1 min obtained by a radiochemical milking technique. The beta- and gamma-radiations of ^{146}Ce and ^{145}Ce were studied and partial decay schemes have been formulated. An interesting feature is the observation of allowed beta-transitions (log ft values = 4.2 – 5.0) in the decay of both nuclides. Total beta-decay energies of 1.10 ± 0.10 and 2.5 ± 0.2 MeV were determined for ^{146}Ce and ^{145}Ce, respectively. Preliminary studies indicate that the column technique used in these investigations can also be adapted for use in similar studies of other short-lived nuclides such as the fission-product Mo – Tc and Zr – Nb techniques. (auth)

32619 PRODUCTION OF HEAVY ELEMENTS IN A RECENT LOS ALAMOS THERMONUCLEAR TEST. Hoffman, D. C. Ark. Fys., 36: 533-7(1967).

A low-yield thermonuclear device, designed to give a high neutron flux region for the purpose of producing heavy elements by multiple neutron capture, was recently tested underground in Nevada. This device, Cyclamen, containing ^{238}U and ^{243}Am target material, was the most successful heavy element producer to date, giving an order of magnitude more ^{257}Fm than any previous Nevada test. The mass abundance data indicated that still heavier nuclides should have been produced in amounts sufficient to permit detection, but no evidence for them has yet been found. Although it was not expected that the even-mass chains would have survived, predicted alpha half-lives for ^{259}Fm and ^{259}Md are ≈80 days, and it might be expected that their spontaneous fission half-lives would be in the range of about a month. However, if one assumes that these nuclides were produced with an abundance of $^1/_{30}$th that of the mass 257 chain, the present data permit the following half-life limits to be set: ^{259}Fm($t_{1/2}$(SF) ≤ 5.5 hr. or ≥ 7.5 years, $t_{1/2}(\alpha) \geq 30$ years) and ^{259}Md($t_{1/2}(\alpha) \geq 30$ years). The implications of failure to find evidence for mass 259 is discussed. (auth)

32620 EFFECT OF 1/E SPECTRUM ON EFFECTIVE SELF-SHIELDING FACTOR OF ^{238}U ABSORPTION NEAR Na RESONANCE. Tone, Tatsuzo (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 5: 195-6(Apr. 1968).

The effect of resonance scattering by Na on the effective resonance absorption of ^{238}U was previously investigated (J. Nucl. Sci. Technol., 4: 601(1967)) without taking into account the 1/E dependence of the spectrum. The effect of this approximation is investigated by calculations that take into account the 1/E contribution to the spectrum. (D.C.W.)

32621 RATIOS OF FAST NEUTRON FISSION CROSS SECTIONS OF ^{233}U, ^{235}U, AND ^{239}Pu. Nesterov, V. G.; Smirenkin, G. N. At. Energ. (USSR), 24: 185-7(Feb. 1968). (In Russian).

Relative fission cross sections of σ_3/σ_5 (^{233}U to ^{235}U) and of σ_9/σ_5 (^{239}Pu to ^{235}U) were determined over a neutron energy E of 0.3 to 2.5 MeV at a relative accuracy of 1 to 2% by measuring the number of fissions in a double ionization chamber containing layers of the isotopes which were to be compared. Since the fission cross section for the ^{235}U isotope is well known with a high accuracy of 2.5 to 3% at higher neutron energies, it becomes possible to derive more accurate data on the cross sections of ^{233}U and ^{239}Pu. The results were compared with the data compiled by Davey, and it was found that the two sets of data were in good agreement at $E_n < 0.7$ MeV, but deviated from each other by 7 to 10% at higher values of E_n. The results are in good agreement with the data of Lamphere. (TTT)

32622 EMISSION OF ENERGY DURING THE RADIOACTIVE DECAY OF A NUMBER OF TRANSURANIC ISOTOPES (^{238}Pu, ^{242}Cm, ^{244}Cm, AND ^{252}Cf). Romanov, Yu. F.; Krivokhatskii, A. S. At. Energ. (USSR), 24: 190-1(Feb. 1968). (In Russian).

The energy evolved per unit of time due to alpha decay (λ_α) and spontaneous fission (λ_f) is determined by the expression: $W = \lambda_\alpha NE_\alpha + \lambda_f NE_f$. Here N is the number of nuclei of the isotope at time t, and E_α and E_f are the alpha decay energy and spontaneous fission energy respectively. The contribution from spontaneous fission can be neglected in the case of ^{238}Pu, ^{242}Cm, and ^{244}Cm; and it is found that the energy evolution per gram of isotope per sec is 0.580 watts for ^{238}Pu, 122 watts for ^{242}Cm, and 2.93 watts for ^{244}Cm. The value for ^{252}Cf is 39.7 watts, about one-half of which is due to spontaneous fission (19.1 watts). Thus 1 g ^{242}Cm is energetically equivalent to 210 g ^{238}Pu, 42 g ^{244}Cm, and 3.1 g ^{252}Cf. The energy emission in watt-seconds and the integral energy emission Q are given for these four isotopes as a function of decay time. (TTT)

32623 STRUCTURE OF THE CROSS SECTION OF THE ^{208}Pb(γ,Tn) REACTION. Goryachev, B. I.; Ishkhanov, V. S.; Kapitonov, I. M.; Shevchenko, V. G. (Moscow State Univ.). JETP Lett. (USSR) (Engl. Transl.), 7: 161-2(Mar. 1968).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 7: 210-2(Mar. 20, 1968).

The cross section for photoneutron production on ^{208}Pb lead-208 was investigated from threshold to 22 MeV. The reaction yield curve was measured in steps of 0.125 MeV using direct registration of the neutrons with a spherical detector containing 80 counters filled with BF_3 gas. The Penfold – Leiss method was used to calculate the cross section of the reaction ^{208}Pb(γ,Tn) from the data. (D.C.W.)

32624 METHOD FOR THE STUDY OF ANGULAR AND ENERGY DISTRIBUTION OF FISSION FRAGMENTS. Khare, L. R. (Indian Inst. of Tech., Kanpur). pp 548-53 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

A method for the study of angular and energy distribution of fission fragments as a function of fission gamma-ray energy is described, in which a special electronic technique employing digital voltmeters, electronic counters, and a memory circuit that is capable of recording all the necessary information with good accuracy and good statistics in a short time, is used. The method utilizes the fact that there is a time-delay of the order of a few millisec between the collection of electrons and positive ions released in a gas like argon by the fission fragments. This fact enables one to determine the angles at which the fission fragments are emitted, the pulse height giving the kinetic energy. Modifications and possible applications of the method are suggested. (auth)

32625 RANGE MEASUREMENTS OF FISSION FRAGMENTS IN THERMAL FISSION OF ^{235}U. Rangarajan, R.; Iyengar, K. N.; Hiranandani, M. R. (Tata Inst. of Fundamental Research, Bombay). pp 554-60 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

Simultaneous measurements of the ranges of the two fragments in the thermal fission of ^{235}U were made using a Lexan detector. It is shown that from these range measurements, the masses of the fragments can be obtained using range-energy relations and an iteration procedure. The average ranges of the light and heavy groups are found to be 20.1 ± 0.038 μ and 16.3 ± 0.037 μ, respectively. (auth)

32626 RESONANCE SELF-SHIELDING IN ^{235}U AND ^{239}Pu. Singh, R. Shankar (Bhabha Atomic Research Centre, Trombay, India). pp 591-6 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

The uncertainties in the present knowledge of resonance parameters for fissile nuclei like ^{235}U and ^{239}Pu were pointed out and their effects on the self-shielded effective cross sections computed for these elements were illustrated. For ^{235}U, the serious errors in evaluated cross sections as a result of extrapolating the fission width values from the resolved resonance parameters to the unresolved statistical region were pointed out. For ^{239}Pu, the effect of using unresolved resonance parameters in the resolved resonance region, as well as the improvements obtained by using spin-dependent fission width values, were observed. The need for extending the resolved resonance region and determining the fission widths and the spins of these levels accurately was emphasized. (auth)

32627 HIGH RESOLUTION X-RAY SPECTROMETER USING LITHIUM DRIFTED SILICON DETECTOR FOR NUCLEAR CHARGE DETERMINATION. Kapoor, S. S.; Rama Rao, P. N. (Bhabha Atomic Research Centre, Trombay, India). pp 401-6 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

A high-resolution x-ray spectrometer has been set up using a lithium-drifted silicon detector with a field effect transistor (FET) directly mounted on the detector to serve as a low noise first stage of the preamplifier. Both the detector and the FET are cooled in a cryostat to near liquid nitrogen temperatures for optimum energy resolution. The energy resolution so far achieved, as measured in terms of full width at half maximum of the 59.57-keV line of ^{241}Am, is about 2.5 keV; but attempts are being made to improve the resolution further. This system is intended for use in the determination of nuclear charges of the fission fragments through a study of characteristic K x rays emitted by them and more generally for the nondestructive identification of elements by physical means. Certain x-ray spectra with this set-up are presented. (auth)

32628 MEASUREMENT OF CAPTURE GAMMAS FROM RESONANCE ABSORBERS USING LEAD SPECTROMETER. Chandramoleswar, K.; Navalkar, M. P.; Phiske, M. R.; Ramakrishna, D. V. S.; Sadavarte, S. K. (Bhabha Atomic Research Centre, Trombay, India). pp 409-15 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

The lead spectrometer built at Trombay has been described in papers presented at previous symposia. The results of capture gamma measurements with resonance absorbers such as Ag, Au, Ta, Ho, Tb, etc., are reported. The experimental measurements in the form of mean energy and half width have been compared with those calculated on the basis of time moments which incorporate effects due to thermal motion on the dispersion of neutron distribution. The effects of finite burst width and channel width, Doppler broadening of resonances, admixture of oxygen introduced as a result of casting, etc., have also been taken into account in the calculations. (auth)

32629 THERMAL NEUTRON CAPTURE GAMMA-RAYS FROM ^{59}Co(n,γ)^{60}Co AND ^{159}Tb(n,γ)^{160}Tb REACTIONS. Sriramamurty, K.; Suryanarayana, Ch.; Sastry, D. L.; Jnanananda, Swami (Andhra Univ., Waltair, India). pp 416-21 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220-(Vol.2).

The reactions ^{59}Co(n,γ)^{60}Co and ^{159}Tb(n,γ)^{160}Tb were studied to investigate the low-lying excited states of the product nuclei ^{60}Co and ^{160}Tb, employing a thermal neutron beam and a fast-slow triple coincidence scintillation spectrometer at CIRUS Reactor. Some of the observed singles and coincidence spectra in ^{60}Co and ^{160}Tb studies are presented and discussed. Gamma-gamma directional correlation of 6.849 MeV → 0.767 MeV → 0 and 1.61 MeV → 0.775 → 0 cascades from the ^{89}Y(n,γ)^{90}Y and ^{95}Mo(n,γ)^{96}Mo reactions, respectively, were also studied. The respective correlation functions obtained from the observed anisotropies are in good agreement with the previous values. (auth)

32630 ANGULAR ANISOTROPY OF FISSION FRAGMENTS IN 3-MeV NEUTRON INDUCED BINARY AND TERNARY FISSION OF ^{235}U. Nadkarni, D. M. (Bhabha Atomic Research Centre, Trombay, India). pp 318-24 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

The anisotropy of the angular distribution of fission fragments with respect to the incident neutron direction in neutron-induced binary and ternary fission ^{235}U at 3 MeV was determined. Solid-state detectors were used to detect fission fragments and long-range alpha particles emitted in fission. The anisotropy of fission fragments in ternary fission is found to be different both in magnitude and sign from that in binary fission. Various models of ternary fission process are discussed in the light of these results. (auth)

32631 P-WAVE NEUTRON FISSION OF ^{235}U. Mehta, G. K. (Indian Inst. of Tech., Kanpur); Lebowitz, J. M.; Melkonian, E. pp 327-33 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

The mass distribution of fission fragments was measured with back-to-back type of arrangement using surface-barrier silicon detectors for several different neutron energies in the range where p-wave interaction predominates. A 5.5-MeV Van de Graaff generator was used to produce neutrons of energies 60 keV, 120 keV, 200 keV, 300 keV, 500 keV, 750 keV, 1 MeV, and 2 MeV utilizing the Li(p,n)Be reaction. Valuable information on the detailed kinetic-energy distribution and the mass distribution for these neutron energies was obtained. (auth)

32632 COLLECTIVE NATURE OF 1.29-MeV 2^+ STATE OF ^{116}Sn. Sen, S. (Saha Inst. of Nuclear Physics, Calcutta). pp 281-5 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

Exact zero-range force calculations were performed to explain the collective nature of the 1.29-MeV 2^+ state of ^{116}Sn nucleus containing 50 protons and 66 neutrons. Considering only 1p–1h neutron excitation, quite satisfactory agreement with experimental results was obtained. The δ-force strength, however, is somewhat large in this case. (auth)

32633 SHELL MODEL SPECTRA IN ODD MASS INDIUM ISOTOPES. Pandharipande, V. R. (Tata Inst. of Fundamental Research, Bombay). pp 261-5 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

The shell-model spectra of odd-mass indium isotopes were calculated using an effective residual interaction defined by its matrix element $V_{j_1j_2j_3j_4J}$ as follows: $V_{j_1j_2j_3j_4J} = V_J < j_1j_2J|\delta(\pi_1 - \pi_2)[1 - \alpha + \alpha(\sigma_1 \cdot \sigma_2)]|j_3j_4J$, where $V_J = V_0$ if $j_1 \pm j_2 = J$ or $j_3 \pm j_4 = J$, and $V_J = V$ if $j_1 \pm j_2 \neq J$ and $j_3 \pm j_4 \neq J$. Satisfactory agreement with the experimentally observed levels is obtained. (auth)

32634 ENERGY DISTRIBUTION LIGHT CHARGED PARTICLES FROM THERMAL FISSION OF ^{235}U, ^{239}Pu, AND SPONTANEOUS FISSION OF ^{252}Cf. Hattangadi, V. A. (Bhabha Atomic Research Centre, Trombay, India). pp 334-9 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

The energy distributions of the long-range alpha particles emitted in the thermal fission of ^{235}U and ^{239}Pu and in the spontaneous fission of ^{252}Cf were determined using a surface-barrier-type semiconductor detector. A Xe gas scintillator detected the fission above the pile-up noise due to the natural α activity of the source. The energy distribution of the long-range alpha particles was then found, using an iterative method of unfolding, from the pulse-height spectrum after correcting for the nonlinear loss of energy by the alpha particles in the aluminum backing which they have to traverse before entering the semiconductor detector. (auth)

32635 ANGULAR DISTRIBUTION OF THE PROMPT-GAMMA RAYS IN THE SPONTANEOUS FISSION OF ^{252}Cf. Kapoor, S. S.; Ramamurthy, V. S.; Rama Rao, P. N.; Murthy, S. R. S. (Bhabha Atomic Research Centre, Trombay, India). pp 340-4 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

The angular anisotropy of prompt gamma rays with respect to the fission axis was determined for different gamma ray energies in the case of spontaneous fission of ^{252}Cf. The gamma rays were detected with a NaI(Tl) scintillation crystal in fast coincidence with two fission fragment detectors placed along and perpendicular to the direction of gamma rays. The number of fragment-gamma coincidences for gamma rays emitted at 0 and 90° with the fission axis and the coincident gamma pulse height were simultaneously recorded on a two-parameter pulse-height analyzer. The results on the anisotropy for different gamma-ray energies are presented and discussed. (auth)

32636 DETERMINATION OF THE STATIC QUADRUPOLE MOMENTS OF THE FIRST 2^+ STATES OF ^{194}Pt, ^{196}Pt, AND ^{198}Pt. Glenn, J. E.; Saladin, J. X. (Univ. of Pittsburgh). Phys. Rev. Lett., 20: 1298-1300(June 3, 1968).

Static and dynamic electric quadrupole moments of the first 2^+ states in ^{194}Pt, ^{196}Pt, and ^{198}Pt were determined from Coulomb-excitation cross sections for the scattering of 42-MeV ^{16}O ions measured as a function of scattering angle. The results are compared with recent calculations performed by Kumar and Baranger. (auth)

32637 PROPERTIES OF THE NEUTRONS EMITTED IN THE LONG-RANGE ALPHA FISSION OF ^{252}Cf. Nardi, Eran (Israel Atomic Energy Commission, Yavne, Israel. Weizmann Inst. of Science, Rehovoth, Israel); Fraenkel, Zeev. Phys. Rev. Lett., 20: 1248-51(May 27, 1968).

The long-range alpha (LRA) fission neutrons of ^{252}Cf were studied in a four-parameter correlation experiment, and the behavior of the average number of neutrons as a function of fragment mass and total fragment kinetic energy was found to be very similar in binary and LRL fission. It was concluded that binary and LRA fission have essentially the same scission configuration. The mechanism of alpha emission and the fragment stiffness coefficients are also discussed. (auth)

32638 FAST NEUTRON REACTION CROSS SECTIONS AT 14 MeV IN SOME RARE-EARTH ISOTOPES. Prasad, P. Rama; Rama Rao; J.; Kondaiah, E. (Andhra Univ., Waltair, India). pp 355-62 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

The cross sections for the reactions ^{142}Nd(n,2n)^{141}Nd, ^{153}Eu(n,2n)-^{152}Eu, ^{159}Tb(n,2n)^{158}Tb, ^{160}Gd(n,2n)^{159}Gd, ^{158}Gd(n,α)^{155}Sm, ^{75}As(n,p)-^{75}Ge, and ^{27}Al(n,p)^{27}Mg were measured relative to the ^{27}Al(n,α)^{24}Na cross section, which was taken to be 115 ± 5 mb. Isomeric cross-section ratios were determined for the reactions ^{142}Nd(n,2n)^{141}Nd, ^{153}Eu(n,2n)^{152}Eu, and ^{75}As(n,p)^{75}Ge. (D.C.W.)

32639 THE GYROMAGNETIC RATIO OF 379-keV LEVEL OF ^{169}Tm. Nigam, A. K.; Bhattacharyya, R. (Saha Inst. of Nuclear Physics, Calcutta). pp 435-40 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27-March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

The g-factor value g = 1.38 for the 379-keV level ($T_{½} = 50 \times 10^{-9}$ sec) of ^{169}Tm was measured by observing the perturbed angular correlation in the applied magnetic field with the help of the differential-delay-reverse-field method. (auth)

32640 NUCLEAR g-FACTOR OF THE 57-keV STATE IN ^{143}Pr. Tandon, P. N.; Devare, S. H.; Devare, H. G. (Tata Inst. of Fundamental Research, Bombay). pp 441-6 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

The nuclear "g" factor of the 57 keV state in ^{143}Pr was measured using the perturbed angular correlation technique in an external magnetic field. Differential angular correlation was done to check the possible attenuations due to time dependent perturbations. The measurements were made in different chemical environments—liquid sources in the chloride form and powder sources in cubic CeO_2 form. (auth)

32641 THE NUCLEAR COUPLING SCHEME OF ^{121}Sb AND ^{123}Sb. Joshi, M. C. (Tata Inst. of Fundamental Research, Bombay). pp 450-4 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

A detailed study on the level structure of ^{121}Sb and ^{123}Sb using different nuclear reactions was reported previously. For further information on the levels, the gamma spectra in the decay of ^{121m}Te and ^{123}Sn were re-examined using a Ge(Li) detector. More accurate determination of energies of the gamma rays in the decay of ^{121}Te, combined with the previous results, suggests two levels at 1033 and 1137 keV, which decay to the 35-keV ($7/2^+$) level of ^{121}Sb. Whereas the 1024- and 1143-keV levels excited in the inelastic scattering (^{16}O, ^{16}O′γ) and (d,d′) measurements decay mainly to the ground state of ^{121}Sb ($5/2^+$). The nature of the levels is discussed. (auth)

32642 THE LEVEL STRUCTURE OF ^{117}In. Prasad, K. G.; Pandharipande, V. R.; Sharma, R. P. (Tata Inst. of Fundamental Research, Bombay). pp 457-60 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

The energy levels of ^{117}In were investigated using the decay of ^{117}Cd and ^{117m}Cd. Gamma spectra obtained with a Ge(Li) detector revealed the presence of 49 gamma transitions extending up to 2400 keV in energy. Two excited states in the low-energy region were found to have half-lives of 4.8 and 59 nanoseconds. The character of the low-lying energy levels was determined from $\gamma-\gamma$, $\beta-\gamma$, and delayed angular correlation measurements. The nature of the energy levels above 2000 keV was determined from the β branching to these levels and the singles γ spectra. (D.C.W.)

32643 LIFETIME MEASUREMENTS OF THE EXCITED STATES OF ^{46}Ti, ^{84}Rb, ^{99}Tc, ^{162}Dy, ^{164}Er, AND ^{196}Au. Sethi, B.; Mukherjee, S. K. (Saha Inst. of Nuclear Physics, Calcutta). pp 462-9 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

The lifetimes of the excited levels of ^{46}Ti, ^{84}Rb, ^{99}Tc, ^{162}Dy, ^{164}Er, and ^{196}Au were measured with the method of delayed coincidences and a time-to-pulse-height converter. Typical time resolution of this apparatus, using NE102 plastic scintillators, RCA 7850 photomultiplier tubes, and gamma rays of ^{60}Co source, was $2\tau_0 = 6.4 \times 10^{-10}$ sec with a slope of the prompt curve $T_{½} = 1.4 \times 10^{-10}$ sec. (auth)

32644 LIFETIME OF THE 531-keV STATE IN ^{147}Pm. Rao, M. T. Rama; Ramamurthy, V. V.; Lakshminarayana, V. (Andhra Univ., Waltair, India). pp 470-5 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

The lifetime of the 531-keV state in ^{147}Pm was determined using a fast time-to-amplitude converter by the centroid shift technique. The value obtained for the mean life is $1.2 \pm 0.12 \times 10^{-10}$ sec. The transition probabilities for the M1 and E2 parts are estimated. It shows strong M1 hindrance as in the case of the 91-keV transition. It thus appears that the 531-keV state contains significant ($d\,5/2$) amplitude. (auth)

32645 DECAY OF ^{99}Mo. Jagam, P.; Lakshminarayana, V. (Andhra Univ., Waltair, India). pp 477-81 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

The decay of ^{99}Mo is investigated by sum and sum-peak coincidence techniques using a 100-channel analyzer. The 7 cm-zero bias sum-peak coincidence spectrum shows peaks at energies 1270, 1130, and 920 keV. The sum-coincidence spectrum with gate at 1270 keV appears to arise out of 1 cascade (1130 + 140 keV). The spectra with gates at 1130 and 920 keV confirm the cascade relations proposed earlier. The half-life of the various components is followed in the 4π sum-peak coincidence arrangement and is consistent with the assignment of 66 hours for the decay of ^{99}Mo. (auth)

32646 GAMMA-GAMMA ANGULAR CORRELATIONS IN ^{147}Nd. Rajput, M. S.; Sehgal, M. L. (Aligarh Muslim Univ., India). pp 495-500 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

The angular correlations of three gamma cascades in ^{147}Pm were studied. The observed angular correlation functions for these cascades are: $W(\Theta, 91 - 92) = 1 + (0.058 \pm 0.039)P_2(\cos\Theta) - (0.049 \pm 0.042)P_4(\cos\Theta)$; $W(\Theta, 442 - 91) = 1 + (0.053 + 0.012)P_2(\cos\Theta) - (0.032 \pm 0.016)P_4(\cos\Theta)$; and $W(\Theta, 599 - 91) = 1 + (0.061 \pm 0.018)P_2(\cos\Theta) - (0.052 \pm 0.022)P_4(\cos\Theta)$. From the known log ft values of the beta transitions and the ground-state spin of ^{147}Pm, the spins $1/2$, $5/2$, and $5/2$ are assigned to the levels at 182, 533, and 690 keV, respectively. From the graphical analysis of these functions, the multipole admixtures of the gamma rays are determined. (auth)

32647 ELASTIC SCATTERING OF 1.33-MeV GAMMA RAYS AT HIGH MOMENTUM TRANSFER AS A FUNCTION OF ATOMIC NUMBER. Basavaraju, G.; Kane, P. P. (Indian Inst. of Technology, Bombay). pp 507-12 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

Differential cross sections for the elastic scattering of 1.33-MeV gamma rays through 124.5° by Al, Cu, Zr, Mo, Ag, Ta, W, Hg, and Pb were measured. The targets were comparatively thin, the thickness of the majority of the scatterers being about $\frac{1}{3}$ μ. The angular resolution was about 5° or better. The contribution of inelastic scattering to the measured counts was determined by a combination of pulse height analysis, absorption data and theoretical estimates. The results for elements of low atomic number are in fair agreement with previous data and the expectations on the basis of predominant Thomson scattering. But the results for heavy elements are substantially lower than the previous results, indicating perhaps a more accurate extraction of the elastic scattering events from the total counts. (auth)

32648 MeV NEUTRON TOTAL CROSS SECTIONS OF TANTALUM AND TUNGSTEN ISOTOPES. Martin, Richard Charles. Troy, N. Y., Rensselaer Polytechnic Inst., 1967. 106p.

Thesis.

The success of the optical model in describing neutron total cross sections σ_T clearly establishes the fact that the general behavior of these cross sections depends strongly on nuclear dimensions, and should therefore be sensitive to nuclear deformations. The effects of deformations on the total cross sections of ^{181}Ta, ^{182}W, ^{184}W, and ^{186}W have been investigated first through rough calculations estimating variations in σ_T arising from quadrupole deformations and second by measurements of σ_T for these four nuclides and natural tungsten. The calculations were made by considering the "effective radii" presented to a neutron incident on a deformed nucleus and then applying the usual optical model results in a slightly modified form. Some parameter adjustments were first made to obtain a fit to a spherical nucleus, ^{197}Au. The results of these estimates suggested that the peaks of the contributions to σ_T from neutrons of different angular momenta should be shifted downward in energy from their spherical values by quadrupole deformations and that these results should be observable in experimental data. The experiments were performed over an energy range from 0.6 to 25 MeV with a neutron time-of-flight spectrometer system using the 100-meter flight path at the Rensselaer 100-MeV electron linac. The overall time resolution of the system was 25 nsec. The statistical errors of the results comprising five-channel averages of the 1024-channel original data were less than 2% for energies above 0.7 MeV. A detailed analysis of the experimental results and data reduction procedures indicated that the relative values of σ_T between these nuclides should be good to within statistical uncertainties and the absolute values almost as good for energies between 0.7 and 15 MeV. Outside of this energy range, systematic errors make the results less reliable. The experimental data confirmed to a remarkable extent the results of the preliminary calculations. The expected shifts in the σ_l (i.e., the contribution to σ_T from neutrons of angular momentum l) appear to "fill in" a minimum at 1 MeV observed for spherical nuclei. Most striking, however, was the correlation between the behavior of σ_T and the measured electric quadrupole deformations for energies between 2 and 7 MeV. In this region, σ_T declines with increasing energy from a value of about 7 barns at 2 MeV to about 5 barns at 7 MeV. The extent by which this down-slope shifted to lower energies reflected exactly the measured quadrupole deformations and occurred just as predicted by the calculations in which σ_2 and σ_3, the largest contributors to σ_T in this energy range, were similarly shifted to lower energies. There appear to be clear indications, therefore, that nuclear deformations do evidence themselves in neutron total cross sections and that a major effect is to shift the peaks in the σ_l comprising σ_T to lower energies. (Disser. Abstr.)

32649 MODIFIED NILSSON ORBITALS AND THEIR APPLICATIONS IN THE ANALYSIS OF (d,p) REACTIONS ON EVEN-A RARE EARTH NUCLEI. Krishna, G. Rama; Mukherjee, P. (Saha Inst. of Nuclear Physics, Calcutta). pp 99-104 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

Data on (d,p) reactions on even–A rare-earth nuclei show that the wave functions tabulated by Nilsson do not give correct cross-section ratios among the levels in a rotational band. The decoupling parameter "a" for the $K = \frac{1}{2}$ bands also shows systematic deviations from the values predicted by Nilsson. Attempts have been made to get better wave functions for the intrinsic states in the rare-earth region, by diagonalizing the Nilsson Hamiltonian with a more realistic choice of the χ and the μ parameters. The latter are chosen by a least square fit with the available single-particle states in the N = 5 and 6 shells. The wave functions obtained by this procedure are used to get the (d,p) cross-section ratios for several rotational bands in Yb, Dy, Hf, and W isotopes. (auth)

32650 COULOMB EXCITATION OF ^{127}I. Devare, S. H.; Tandon, P. N.; Devare, H. G. (Tata Inst. of Fundamental Research, Bombay). pp 189-93 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

The gamma spectra in the Coulomb excitation of ^{127}I were studied using both a scintillation and a high-resolution Ge(Li) solid-state detector. Alpha particles and protons accelerated up to 5.25-MeV energy in the Van de Graaff machine at Trombay were used for these studies. The gamma spectra recorded at various charged-particle energies were analyzed, and the excitation curves were plotted from the thick target yields. The B(E2) values for the excitation of various levels were calculated taking into account the branchings and conversion coefficients known from radioactive decay. (auth)

32651 STUDY OF THE ENERGY LEVELS OF ODD MASS ISOTOPES OF In, Ag, Rh, AND Nb BY THE INELASTIC SCATTERING OF PROTONS. Pandharipande, V. R.; Prasad, K. G.; Sharma, R. P. (Tata Inst. of Fundamental Research, Bombay). pp 182-8 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220–(Vol.2).

The energy levels of the odd mass isotopes of In, Ag, Rh and Nb were studied by the inelastic scattering of protons of energy 3.5, 4.0, and 4.5 MeV. The gamma radiation emitted in this reaction was observed on a lithium-drifted germanium detector. The yield of various transitions as a function of energy was determined. The various excited states in the above-mentioned nuclei were established by combining the present data with the earlier known energy levels in this region. The character of the energy levels excited in this process was discussed. (auth)

32652 AVERAGE ENERGY OF PROMPT NEUTRONS IN SPONTANEOUS FISSION OF ^{252}Cf AND THERMAL NEUTRON-INDUCED FISSION OF ^{235}U. Kluge, Gyula; Lajtai, Albert. KFKI (Kozp. Fiz. Kut. Intez.) Kozlem., 16: 129-35(1968). (In Hungarian).

The initial temperatures of fission fragments are calculated with the use of a statistical model. The initial temperature permits one to evaluate the average neutron energies by making use of the result obtained by Le Counteur and Lang for an evaporation cascade. The average neutron energies thus predicted are compared with the experimental values reported for ^{252}Cf and ^{235}U. The good agreement between the predictions and the experimental values seems to indicate the usefulness of the method for the evaluation of average neutron energies in other cases of nuclear fission as well. (auth)

32653 PROCEEDINGS OF THE NUCLEAR PHYSICS AND SOLID STATE PHYSICS SYMPOSIUM, KANPUR, FEBRUARY 27–MARCH 3, 1967. NUCLEAR PHYSICS. Trombay, India, Bhabha Atomic Research Centre, 1967. 619p. (CONF-670220–(Vol.2)).

Separate abstracts were prepared for the 73 papers for which the full text is included. (D.C.W.)

For abstracts of individual papers see: 30844, 30845, 30851, 30852, 30920, 31781, 31791, 31814, 32468, 32485–32487, 32508–32511, 32530–32541, 32552, 32554, 32555, 32557–32559, 32624–32635, 32638–32647, 32649–32651, 32664, 32707–32709, 32711–32715, and 32728–32732.

32654 MEASUREMENT OF THE g FACTOR OF THE SECOND EXCITED, $I^\pi = 2^+$, TWO-PHONON VIBRATIONAL STATE IN ^{106}Pd. Bowman, J. D.; Kaufmann, E. N.; Bhattacherjee, S. K.; Levanoni, M. (California Inst. of Tech., Pasadena). Phys. Rev. Lett., 20: 1176-7(May 20, 1968).

The g factor of the second, $I^\pi = 2^+$, two-phonon vibrational state in ^{106}Pd was measured to be g = 0.370 ± 0.071 using the internal magnetic field of Pd in Fe. (auth)

32655 EXPERIMENTAL EVIDENCE FOR THE DOUBLE-BETA DECAY OF ^{130}Te. Kirsten, T. (State Univ. of New York, Stony Brook); Schaeffer, O. A.; Norton, E.; Stoenner, R. W. Phys. Rev. Lett., 20: 1300-3(June 3, 1968).

It is shown that double-beta decay occurs in nature. The half life of ^{130}Te is $10^{21.34 \pm 0.12}$ yr. (auth)

32656 MEASUREMENT OF THE CONVERSION RATIO FOR ^{207}Bi. Andersen, V.; Christensen, C. J. (Danish Atomic Energy Commission Research Establishment, Riso). Nucl. Phys., A113: 81-5(1968).

The conversion ratios for the 570 and 1064-keV transitions in ^{207}Bi were measured with a $4\pi\beta$ spectrometer. The α_K values were 0.0156 ± 3.0% and 0.084(±10%), respectively, in reasonable agreement with theory. (auth)

32657 PROTON QUASI-PARTICLE STATES IN ^{143}Pm. Hansen, Ole (Univ. of Copenhagen); Nathan, O.; Vistisen, L.; Chapman R. Nucl. Phys., A113: 75-80(1968).

The proton quasi-particle spectrum of ^{143}Pm was studied by means of the ^{144}Sm(t, α) reaction. A total of nine levels were excited up to 2 MeV of excitation. The results are compared with the predictions from pairing theory. (auth)

32658 STUDY OF THE DECAY OF ^{121}I. Sergolle, Henri (Institut de Physique Nucleaire, Essonne, France). Compt. Rend., Ser. A and B, 266: 434-6(Feb. 12, 1968). (In French).

The study of the γ rays associated with the decay of ^{121}I, made with Ge detectors and a $\gamma-\gamma$ coincidence circuit, lead to the proposal of a partial level scheme for the isotope ^{121}Te. (tr-auth)

32659 ALPHA PARTICLE SPECTRA IN THE DECAY OF EXCITED STATES OF ^{148}Sm WITH SPINS 3^- AND 4^-. Popov, Yu. P.; Stempinskii, M. (Joint Inst. of Nuclear Research, Dubna, USSR). JETP Lett (USSR) (Engl. Transl.), 7: 97-9(Feb. 20, 1968).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 7: 126-30(Feb. 20, 1968).

The spectra of the α particles in the resonances of the reaction ^{147}Sm(n,α)^{144}Nd were investigated, with 200-keV resolution for E_α = 4.2 MeV, using a double ionization chamber with a grid. The spectra of α particles in the 3.4- and 18.3-eV resonances with J^π = 3^- and 4^-, respectively, were obtained. The values of reduced partial widths were obtained by comparison of the intensities of the α transitions to individual states. (D.C.W.)

32660 PHOTOEXCITATION OF THE LOW-ENERGY NUCLEAR LEVELS OF ^{115}In. Boivin, Michel; Heno, Yvonne (Laboratoire de Chimie Physique, Paris). Compt. Rend., Ser. A and B, 266: 437-9(Feb. 12, 1968). (In French).

The photoactivation of the low-energy nuclear levels of ^{115}In was studied. Two levels at 600 and 830 keV, previously described by others, were detected. The calculation of the photoactivation cross section makes it possible to attribute the characteristic $\frac{3}{2}^-$ to the 600-keV level and $\frac{3}{2}^-$ or $\frac{3}{2}^+$ to the 830-keV level. (tr-auth)

32661 NEW NEPTUNIUM ISOTOPES, ^{230}Np AND ^{229}Np. Hahn, R. L.; Roche, M. F.; Toth, K. S. (Oak Ridge National Lab., Tenn.). Nucl. Phys., A113: 206-14(1968). (ORNL-P-3716).

Two new neptunium isotopes ^{230}Np and ^{229}Np were produced by bombarding enriched ^{233}U with protons at the Oak Ridge Isochronous Cyclotron. In the experiments, recoil nuclei ejected from the target were collected and then assayed with an α-particle spectrometer. The ^{230}Np and ^{229}Np isotopes were found to have respective α-particle energies and half-lives of 6.66 ± 0.02 MeV and 4.6 ± 0.3 min and 6.89 ± 0.02 MeV and 4.0 ± 0.2 min. The ^{226}Pa and ^{225}Pa collateral series from the decay of the neptunium parents were also seen. The α-particle energies found for the ^{225}Pa series are more precise than previously available values: ^{225}Pa, 7.25 ± 0.02 MeV (new value); ^{221}Ac, 7.63 ± 0.02 MeV; ^{217}Fr, 8.31 ± 0.02 MeV and ^{213}At, 9.06 ± 0.02 MeV. Evidence for the possible decay of ^{221}Ac via emission of a 7.42 MeV α-particle to an excited state of ^{217}Fr is presented. The α-particle energies measured for ^{230}Np, ^{229}Np and ^{225}Pa verify the predictions of Viola and Seaborg from α-decay systematics. (auth)

32662 THE DECAY OF ^{140}La TO LEVELS IN ^{140}Ce. Baer, H. W.; Reidy, J. J.; Wiedenbeck, M. L. (Univ. of Michigan, Ann Arbor). Nucl. Phys., A113: 33-56(1968).

The decay of ^{140}La to levels in ^{140}Ce has been studied with Ge(Li) spectrometers and $\gamma-\gamma$ coincidence techniques. Precision energy and intensity values for 25 γ-rays are reported. These transitions have been incorporated into a consistent decay scheme which includes an intensity balance for each level. Using the present data and the recent conversion electron data of Karlsson et al., it was possible to determine multipolarities for most of the transitions. The excitation energies (keV), spins and parities proposed for the levels in ^{140}Ce populated via the decay of ^{140}La are 1596.6 (2^+), 1903.5 (0^+), 2083.6 (4^+), 2108.2 (6^+), 2348.4 (2^+), 2350.2 (5^-), 2412.4 (3^+), 2464.4 (3^-), 2481.3 (4^+), 2516.1 (4^+), 2521.8 (2^+), 2547.5 ($1,2^+$), 2899.7 ($1,2^+$), 3118.3 ($1,2^+$), 3319.7 ($1,2^+$). The level at 2108.2 keV (6^+) was deduced to be isomeric. The proposed level scheme is compared with the excitation spectrum observed in the ^{141}Pr(d,^{3}He)^{140}Ce reaction and two spectra calculated using the quasi-particle description of pairing correlations. (auth)

32663 OBSERVATION OF PARITY ADMIXTURES WITH PERTURBED ANGULAR CORRELATIONS. Lewis, R. R. Jr. (Univ. of Michigan, Ann Arbor). Nucl. Phys., A113: 27-32 (1968).

A new parity test is proposed using combined electric and magnetic perturbation of the angular correlation of two gamma rays, one pure and one mixed. The experiment requires a measurement of the asymmetry of the coincidence rate in fixed counters for reversal of an applied magnetic field. An asymmetry of order 10^{-4} is predicted for ^{181}Ta in Hf. Either a single crystal or a powdered source may be used. (auth)

32664 MASS DISTRIBUTION SPECTRUM OF ^{235}U EMPLOYING A RATIO-CIRCUIT. Patwardhan, P. K.; Indurkar, V. S. (Bhabha Atomic Research Centre, Trombay, India). pp 561-9 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220-(Vol.2).

A method for measuring fission-fragment mass distribution is described, in which a ramp voltage is compared with a stretched pulse. The circuitry is described, and other applications of the technique to fission studies are indicated. (D.C.W.)

32665 VARIATIONS OF CHARGE RADII OF Nd FROM K X-RAY ISOTOPE SHIFTS. Bhattacherjee, S. K.; Boehm, F.; Lee, P. (California Inst. of Tech., Pasadena). Phys. Rev. Lett., 20: 1295-7(June 3, 1968).

The variations of nuclear charge radii in isotopes of Nd were determined from K x-ray isotope shifts. The results, $\delta\langle r^2\rangle$, in F^2 are $^{142-144}$Nd, 0.32 ± 0.02; $^{144-146}$Nd, 0.26 ± 0.03; $^{146-148}$Nb, 0.03 ± 0.04; and $^{148-150}$Nd, 0.44 ± 0.02. The odd-even staggering parameters for ^{143}Nd and ^{145}Nd were determined to be γ = 0.60 ± 0.07 and γ = 0.25 ± 0.20, respectively. (auth)

Nuclear Theory

Refer also to abstracts 31999, 32084, 32155, 32435, 32455, 32468, 32480, 32485, 32486, 32490, 32492, 32493, 32497, 32499, 32510, 32512, 32513, 32516, 32518, 32521–32523, 32530, 32535, 32540, 32542, 32543, 32551, 32554, 32555, 32568–32570, 32572, 32573, 32576, 32623, 32633, 32649, 32652, 32674, and 32723.

32666 (KFK-693) METHODIK UND ERGEBNISSE RADIOCHEMISCHER REICHWEITE-UNTERSUCHUNGEN. (Methods and Results of Radiochemical Range Investigations). Muenzel, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Radiochemie). Dec. 1967. 80p. (In German). Dep.

A bibliographic review is made of the methods and results of radiochemical range investigations. The principle of the method and variations on it are described in detail. The equations necessary for evaluation of the experimental results are given. A range-energy relation is derived for the universal application of this method to the study of nuclear reactions. The results of radiochemical range studies are reported. These include verification of the statistical model, studies with direct reactions, and investigations on nuclear fission. (J.S.R.)

32667 (NP-17478) RESIDUAL INTERACTIONS IN FINITE NUCLEI: SOME DEVELOPMENTS. Note No. 160. Boldrighini, C.; Tesei, A. (Rome Univ. (Italy). Istituto di Fisica). Feb. 14, 1968. 30p. Dep.

In the framework of a technique originally proposed by Jean (Nuovo Cimento, 40: 1224(1965)), an exact expression is found for the eigenvalues of several residual interactions in the degenerate model of spherical nuclei. In the nondegenerate model, a general method for numerical calculations is given; in a particular case (small energy gap between the various shells) the first-order correction to the energy matrix is calculated exactly. (auth)

32668 (ORNL-tr-1907) MECHANISM OF INTERACTION OF FAST DEUTERONS WITH NUCLEI. Barashenkov, V. S.; Gudima, K. K.; Toneev, V. D. Translated for Oak Ridge National Lab., Tenn., from report JINR-P2-3356. 18p. Dep. CFSTI.

A theoretical investigation of the interaction of a deuteron with a nucleus at high energy was made considering a nucleus with a sharp boundary (radius = $1.4A^{1/3} \times 10^{-13}$ cm) and assuming that only those deuterons react with the nucleus for which the center of gravity passes at a distance not greater than R + D/2 from the center of the target nucleus. The mean diameter D of the deuteron was taken to be 4.3×10^{-13} cm. It was found that the smearing of the nuclear boundary must be taken into account. (D.C.W.)

32669 (ORO-3346-21) EXPERIMENTAL ASPECTS AND COMPARISONS WITH THEORY OF ORBITAL ELECTRON CAPTURE RATIOS. Fink, R. W. (Georgia Inst. of Tech., Atlanta. School of Chemistry). May 20, 1968. Contract AT(40-1)-3346. 22p. (CONF-680703-1). Dep. CFSTI.

From International Conference on Electron Capture and Higher Order Processes in Nuclear Decay, Debrecen, Hungary.

Recent improvements in experimental techniques for measurement of M/L and L/K capture ratios are surveyed, and the required accuracy for critical comparisons with theoretical calculations is discussed. Examples of recent investigations which illustrate various improved methods and results are discussed (e.g., ^{37}Ar, ^{40}K, ^{125}I, ^{185}Os, ^{194}Hg). Nuclides of interest for further investigations are suggested, together with discussion of source preparation and suitable experimental methods. A need is indicated for accurate measurements of forbidden electron capture transitions, and for theoretical calculations of the effect of forbiddenness on the Bahcall exchange correction. Current work on forbidden transitions is discussed (e.g., ^{59}Ni, ^{81g}Kr, ^{205}Pb). For second-forbidden nonunique ($\Delta I = 2$, no) electron capture transitions (e.g., ^{36}Cl, ^{53}Mn, ^{59}Ni, ^{91g}Nb, ^{93g}Mo, ^{97g}Tc), absolute values of the nuclear matrix elements can be evaluated when both the M/L and L/K ratios and Q_{EC} are known from experiment, as pointed out by Hubbard. Available precision values of M/L and L/K capture ratios are compared critically with theoretical calculations, both with and without correction for electron exchange calculated by Bahcall. The disagreement between experiment and exchange-corrected theory is larger for M/L- than for L/K-ratios for allowed transitions; the theoretical values, based on the Watson-Freeman Hartree-Fock wave functions, are systematically high. The origin of these disagreements may lie with the screening assumptions. Several new calculations of accurate analytical SCF Hartree-Fock wave functions in the low-Z region have been reported recently from which the capture ratios should be calculated to determine whether better agreement can be achieved. (auth)

32670 (SLAC-PUB-409) CALCULATIONS OF THE THREE-NUCLEON LOW-ENERGY PARAMETERS. Noyes, H. Pierre (Stanford Linear Accelerator Center, Calif.); Fieldeldey, H. (Atomic Energy Board, Pretoria (South Africa)). Apr. 1968. Contract AT(04-3)-515. 73p. (CONF-680429-1). Dep. CFSTI.

From Conference on Three-Particle Scattering in Quantum Mechanics, College Station, Tex.

Since exact calculations of the three-nucleon low-energy parameters using separable models assume nuclear forces which do not reproduce experimental two-nucleon data, and variational calculations with "realistic" forces have not converged, comparison of either type of calculation with experiment is premature. However, the exact calculations can be used for parameter studies, and these studies shed some light on which features of the two-nucleon interaction must be known in order to make reliable calculations from first principles. After a review of the mathematical and physical structure of the nonrelativistic quantum-mechanical three-body problem to clarify what physical input is needed, and a review of whether and if so to what accuracy this information is available from two-nucleon experiments, existing calculations of the binding energy of the triton ϵ_t, and of the n-d doublet and quartet scattering lengths, a_2 and a_4, are reviewed from this point of view. So far as two-nucleon input goes, new experimental information has removed a serious source of difficulty by confirming the theoretical prediction from charge-independence that the n-p $^1S_0$ effective range $r_s = 2.73 \pm 0.03$ F, but a comparable sensitivity to the percentage D state in the deuteron (where the evidence is now at least as good for 4½% as for the conventional value of 7%) pointed out by Phillips will require extensive further investigation. Existing calculations of ϵ_t and a_2 do not discriminate clearly between effects due to differences in the models arising from differences in their fit to nucleon-nucleon S phases up to 300 MeV, differences due to different behavior of the phases at infinite momentum, differences (which are quite large between local and separable potentials) near but off the energy shell, and differences in asymptotic behavior far from the energy shell. However, they do show clearly that such differences either separately or in conjunction can lead to differences in the calculated value of ϵ_t of 1 to 4 MeV, and of a_2 of 1 to 2 F. Both uncertainties are one to two orders of magnitude larger than the experimental error in either quantity, and also larger than estimated effects due to three-body forces arising from meson exchange. They also make it likely that, unless further work is done on electromagnetic properties of the two-nucleon system with an eye on extracting off-shell (wave function) information, a discrepancy of a few MeV in ϵ_t between equally realistic models for the nuclear force will continue to exist even after variational and Faddeev calculations have converged to the same unique (mathematically speaking) answers for these models. 131 references. (auth)

32671 (USC-136-138) COMPUTATION OF THE EFFECTIVE SOLID ANGLE IN ANGULAR-CORRELATION EXPERIMENTS USING GAS TARGETS. Bar-Avraham, E.; Lee, L. C. (University of Southern California, Los Angeles. Dept. of Physics). Apr. 1968. Contract AT(04-3)-136. 23p. Dep. CFSTI

A simple method is presented to calculate the effective solid angle for a correlation experiment using a gas target. This method permits one also to calculate the angular spread for each angle setting. A computer program using this method is presented in the appendix. (auth)

32672 NUCLEAR MANY BODY PROBLEMS. Proceedings of the 12th International Summer Meeting in Physics, Herceg Novi, Yugoslavia, 7-19 August 1967. Mihailovic, Miodrag V.; Rosina, Mitja; Strnad, Janez (eds.). Beograd, The Federal Energy Commission of Yugoslavia, 1967. 442p. (CONF-670839).

A collection of 19 lectures dealing with realistic forces in nuclear structure calculations; collective moments and transitions in ^{6}Li and ^{7}Li; Hartree-Fock and Hartree-Fock-Bogolyubov calculations; nonlocal self-consistent potentials in configuration space; superfluid correlations in nuclei; the shell model for nuclei, hypernuclei, and pseudonuclei; deformations in light nuclei; pairing and isospin pairing in a mass formula for light nuclei; Coulomb stripping in the lead region; coupled-channel equations for nuclear reactions; Green's function in nuclear theory; a variational approach for the two-body density matrix; calculation of reaction cross sections by the eigenchannel method; the method of Bogolyubov quasiparticles in nuclear spectroscopy; and a method of using nuclear knowledge in high-energy physics is presented. (D.C.W.)

32673 NUCLEAR RESONANCE FLUORESCENCE TECHNIQUES USING NEUTRON-CAPTURE GAMMA RAYS FOR THE MEASUREMENTS OF NUCLEAR ENERGY LEVEL PARAMETERS. Randall, J. D.; Dowdy, E. J.; Ramchandran, S.; Wilson, W. B. (Texas A and M Univ., College Station). Trans. Amer. Nucl. Soc., 11: 286-7(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32674 OPTICAL MODEL AND THE DISTORTED WAVE METHOD. Baz, A. I.; Demin, V. F.; Zhukov, M. V.; Kuzmin, I. I. Yadern. Fiz., 7: 558-61(Mar. 1968). (In Russian).

On basis of an explicitly solvable model, the physical meaning and the applicability of the deuteron optical potential and the distorted-wave method to the elastic scattering of deuterons and to the stripping reactions were studied. (auth)

32675 ON THE MECHANISM OF THE π MESON DOUBLE CHARGE EXCHANGE ON NUCLEI. Dalkarov, O. D.; Shapiro, I. S. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz., 7: 562-4(Mar. 1968). (In Russian).

The mechanism of double charge exchange of pions on nuclei involving a virtual nucleonic isobar is considered. The differential cross section depending on the momentum transfer and on the excitation energy of a residual nucleus is calculated. (auth)

32676 POLE MODEL OF RADIATIVE CAPTURE OF PIONS BY NUCLEI. Dakhno, L. G.; Prokoshkin, Yu. D. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz., 7: 565-9(Mar. 1968). (In Russian).

Using the pole model, energy spectra and angular distributions of neutrons and γ-quanta produced by the capture of stopped mesons (π) by compound nuclei are calculated. The comparison with experimental data is performed. (auth)

32677 NEW METHOD OF DETERMINING HALF-LIVES USING A MODULATED EXCITATION SOURCE. Foley, John E.; Seale, Robert L. (Univ. of Arizona, Tucson). Trans. Amer. Nucl. Soc., 11: 72(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32678 TO THE THEORY OF RADIATIVE K-CAPTURE. Zon, B. A.; Rapoport, L. P. (Voronezh State Univ., USSR). Yadern. Fiz., 7: 528-40(Mar. 1968). (In Russian).

General formulas for the probability of internal bremsstrahlung following the capture of orbital electrons for the transitions of any order of magnitude of forbiddenness are derived taking into account Coulomb and relativistic effects. The case of K-electron capture is studied in detail. The comparison with the experiment is made. (auth)

32679 ON THE MEAN RADIATIVE WIDTHS OF "HEATED" NUCLEI. Kuklin, R. N. Yadern. Fiz., 7: 541-3(Mar. 1968). (In Russian).

The formula for the mean radiative width in "heated" nuclei obtained previously is specified. Nuclear shells and the excitation energy dependence on the mass number are taken into account. The calculated curve describes the experimental data on the mean widths reasonably well. (auth)

32680 EFFECTS OF IDENTITY OF PARTICLES IN NUCLEAR REACTIONS. Borbei, I.; Dolinskii, E. I. (Inst. of Nuclear Physics, Moscow). Yadern. Fiz., 7: 554-7(Mar. 1968). (In Russian).

Simple formulas are deduced that make it possible to account for exchange effects in the T(a,b)R nuclear reaction amplitude in the most general case. (auth)

32681 ANALYSIS OF SOME DISCREPANCIES IN MASS-SPECTROSCOPIC DATA OBTAINED DURING THE PERIOD OF 1954–1958. Arutyunyants, G. Yadern. Fiz., 7: 570-8(Mar. 1968). (In Russian).

Some discrepancies between the most exact measurements of the light nuclei masses (up to ^{40}Ar) made during the period of 1954–58 on the spectrometers of the Brookhaven and Minnesota groups by the doublet method are considered. Systematic variation of doublet mass differences measured at different times is shown which is difficult to explain by the appearance of accumulated systematic deviations in the device. A new explanation of this effect is proposed which is based on the assumption that the variations of the atom masses are real and of the order of 10^{-7} to 10^{-6} of the mass number per year. In this assumption on the basis of the nuclear drop model, a formula is obtained which describes the variations of the doublet mass differences. The comparison of experimental values with those calculated from formula gives a sufficient agreement. (auth)

32682 ZERO SOUND IN NUCLEI. Lushnikov, A. A. (Inst. of Atomic Energy, Moscow). pp 125-30 of Problema Mnogikh Tel i Fizika Plazmy. Bonch-Bruevich, V. L. Moscow, Izdatel'stvo Nauka, 1967. (In Russian).

The behavior of zero sound in finite nuclei (the wavelength $\lambda \sim R$, nuclear radius) is discussed. The hydrodynamic equation similar to that used previously by Goldhaber et al. is derived from Landau's kinetic equation. A model, for which that equation can be solved, is considered. Some simple estimates of the giant dipole resonance damping are given. The note is based on the results of two previous papers (Nucl. Phys., 66: 35 and 193(1965)). (auth)

32683 SOLUTION OF THE BETHE–GOLDSTONE EQUATION FOR THE REACTION MATRIX IN TWOFOLD MAGIC NUCLEI. Blank, J.; Ulehla, I. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 120-4 of Problema Mnogikh Tel i Fizika Plazmy. Bonch-Bruevich, V. L. Moscow, Izdatel'stvo Nauka, 1967. (In Russian).

A method for the calculation of binding energy and root-mean-square radii in doubly magic nuclei is developed on the basis of the Goldstone's perturbation theory. A solution for the simple one-dimensional model is given. The results obtained prove the validity of the method. (auth)

32684 CHANNELS COUPLING IN NUCLEAR REACTIONS AND THE MANY-PARTICLE SHELL MODEL OF NUCLEI. Balashov, V. V. (Moscow State Univ.). pp 112-19 of Problema Mnogikh Tel i Fizika Plazmy. Bonch-Bruevich, V. L. Moscow, Izdatel'stvo Nauka, 1967. (In Russian).

An approximate version of the unified theory of nuclear reactions is formulated making it possible to connect the general equations of this theory with a model description of the many-particle properties of nuclear structure. (auth)

32685 DISTRIBUTION OF THE MAGNETIC CHARGE IN NUCLEI. Troitskii, M. A. (Inst. of Atomic Energy, Moscow). pp 134-40 of Problema Mnogikh Tel i Fizika Plazmy. Bonch-Bruevich, V. L. Moscow, Izdatel'stvo Nauka, 1967. (In Russian).

The distribution of the magnetic charge in nuclei is considered by using the equations of the theory of the finite Fermi systems. Magnetic dipole and octupole moments and isotopic shift in the hyperfine structure of the atomic spectrum are obtained. (auth)

32686 DISTRIBUTION OF NEUTRONS IN NUCLEI. Elton, L. R. B. (Univ. of Surrey, London). Phys. Lett., 26B: 689-91 (May 13, 1968).

Considerations are presented which indicate that procedures now exist which make it possible to obtain accurate information on the distribution of neutrons in nuclei. However, these procedures make considerable simplifications in their approach to the many-body problem, and verification of their predictions through direct high-energy experiments is urgently required. (auth)

32687 PAIR COLLISIONS IN A LOW-DENSITY FERMI GAS. Amusia, M. Ya.; Efimov, V. N. (Ioffe Inst. of Physics and Tech., Leningrad). Ann. Phys. (N. Y.), 47: 377-403(1968).

An expansion is considered of the ground-state energy and of the single-particle excitation spectrum in powers of a small parameter p_Fa_0 (p_F is the Fermi momentum, a_0 the radius of interaction). The order of the magnitude of the leading triple-collision contribution to the expansion is determined, and the foregoing expansion terms defined only by pair collision parameters are studied. It is shown that the triple-collision contribution is preceded by a term logarithmically dependent on density. It arises due to three-particle correlations at distances lying between $1/p_F$ and a_0. A calculation is carried out of this term in the expansion of the ground-state energy and the single-particle excitation energy. The triple-collision contribution and the logarithmic term in the expansion of the effective mass of single-particle excitations are argued to contain an additional power of p_Fa_0 as compared to the expansion of the ground-state energy and of the single-particle excitation energy. The most detailed study is made of the ground-state energy expansion. There are evaluated here, besides the logarithmic term, all other expansion terms preceding the triple-collision contribution, and a comparison is made with other papers on the subject. The problem is treated by a method presenting an independent interest. A brief discussion is made of the possibility of using the expansion obtained in the evaluation of the role played by repulsive forces in liquid ^{3}He and in nuclear matter. (auth)

32688 T-VIOLATION AND DETAILED BALANCE IN DIRECT REACTIONS. Moldauer, P. A. (Argonne National Lab., Ill.). Phys. Lett., 26B: 713-15(May 13, 1968).

The relation between detailed balance violation in direct reactions and the matrix elements of the T-odd part of H between different target or residual states is calculated. Presently available experiments put a limiting value of 25 keV on the magnitudes of these matrix elements. (auth)

32689 SINGLE-PARTICLE SUM RULES FOR NUCLEI. Clement, C. F. (Atomic Energy Research Establishment, Harwell, Eng.). Phys. Lett., 26B: 710-12(May 13, 1968).

The exchange contribution to the exact model-independent sum rules is examined. It is shown to be related to the spectroscopic factors for single-particle pickup reactions. Consequences for Butler's new stripping theory are noted. (auth)

32690 ANALYSIS AND INTERPRETATION OF ISOMER RATIOS. Sperber, D. (Rensselaer Polytechnic Inst., Troy, N. Y.); Mandler, J. W. Nucl. Phys., A113: 689-96(1968).

Isomer ratios in (n,γ) reactions were analyzed. The analysis shows that this ratio is very sensitive to a small admixture of quadrupole radiation. It also shows that either the strength of the quadrupole radiation is larger than predicted by the single-particle model or that the strength of the dipole radiation is overestimated by this model. (auth)

32691 MODEL-INDEPENDENT EVALUATION OF INELASTIC ELECTRON SCATTERING DATA AT LOW MOMENTUM TRANSFER. Drechsel, Dieter (National Bureau of Standards, Washington, D. C.). Nucl. Phys., A113: 665-75(1968).

At low momentum transfer, electro-excitation experiments may be corrected for the static Coulomb effects in a model-independent way. This is demonstrated in the case of magnetic transitions for various phenomenological current and magnetization distributions. The inclusion of a finite excitation energy gives mainly a kinematical effect. It is further shown that for transverse transitions the notion of a "transition radius" has no model-independent physical meaning and should be avoided. (auth)

32692 BOUND STATES AND LEVINSON'S THEOREM FOR A CLASS OF NON-LOCAL POTENTIALS (s-WAVE). Bertero, M. (Univ., Bonn); Talenti, G.; Viano, G. A. Nucl. Phys., A113: 625-40(1968).

An improvement of the results obtained in a previous paper for a subclass of the class of nonlocal potentials is presented. With this method all the bound-state solutions of Schrödinger's equation are obtained, and it is shown that the total number of bound states and "spurious" bound states (i.e., bound states with positive energy) is finite. Also a representation of the S-matrix in terms of Fredholm's determinants (this representation has been already deduced elsewhere in a formal way) is proved; as a consequence, Levinson's theorem is deduced. (auth)

32693 FURTHER CALCULATIONS ON A SIMPLE TRITON MODEL. Fiedeldey, H. (Atomic Energy Board, Pelindaba, Pretoria); Erens, G.; Van Wageningen, R.; Homan, D. H.; Kok, L. P. Nucl. Phys., A113: 543-56(1968).

The earlier work by two of the authors on a simple triton is extended in two respects. First the equivalent two-body method of Bodmer and Ali is applied to some of the potentials previously considered, and the results are compared. The conclusion is that this method is far superior to previously used methods if applied to systems of three identical spinless particles, and if only product type wave functions are used. In the second place the various methods are applied to the case where the interaction is a Yukawa potential, which has been used by Wong and Zambotti to test their method of solving the Faddeev equation. It is concluded that the methods reported give better results except for very small strength parameters. (auth)

32694 BOSON APPROXIMATION OF NUCLEON PAIRS IN EVEN-EVEN NUCLEI. Taruishi, Koji (Tokyo Univ. of Education). Progr. Theor. Phys. (Kyoto), 39: 53-82(Jan. 1968).

A boson approximation of nucleon pairs (not quasiparticle pairs) is considered with only s and d bosons. Besides one "ideal boson" energy, there are the residual interactions between the bosons which are assumed only as $C^{(2)} \cdot C^{(2)}$ and $C^{(4)} \cdot C^{(4)}$ forces in this paper. The model reduces to the group theory of SU(3) on s-d boson by taking suitable amounts of the energy difference and of the quadrupole interaction between bosons. A gradual transition from vibrational to rotational pattern of the energy systematics and the wave functions with an increase of the order of the interaction strengths are found. The calculated reduced E2 transition rates give the order of the effective charge of a boson. (auth)

32695 NEGLECT OF THE ENERGY-ANGLE CORRELATION IN NONSCATTERING NEUTRON EMISSION REACTIONS. Perkins, S. T. (Lawrence Radiation Lab., Livermore, Calif.). Nucl. Sci. Eng., 31: 156(Jan. 1968).

In nuclear reactions leading to neutron emission, a thorough description of the transfer function is difficult, and simplifying techniques are used to make the analysis amenable to calculation. An approach to partially circumvent this problem, and still include as much of the experimental data as possible, is presented. It is based on neglect of the energy-angle correlation. The transfer function then becomes equal to the product of two independent distributions, one describing the spectral and the other the angular behavior. As a check on the validity of neglecting the energy-angle correlation in reactor analysis, the flux age was calculated in D and Be, for which the (n,2n) branching ratio is relatively large and the reaction anisotropic, thereby providing a worthwhile test of the technique. Results are compared with those obtained by utilizing only the $l = 0$ transfer matrix. (S.F.L.)

32696 A REFORMULATION OF THE DOPPLER EFFECT IN RESONANT NEUTRON CAPTURE. Pettus, W. G. (Babcock and Wilcox Co., Lynchburg, Va.). Nucl. Sci. Eng., 31: 168-9 (Jan. 1968).

The Doppler-broadened neutron resonance capture cross section is derived by using an approach which rigorously accounts for the motion of the target nucleus for arbitrarily high temperatures. In this treatment, the integration variables are taken to be the kinetic energy of the target nucleus in the laboratory system and the angle between the velocity vectors of the neutron and the target nucleus in the L-system. (S.F.L.)

32697 EXCHANGE-FORCES AND ANTISYMMETRIZATION IN A MICROSCOPIC DWBA CALCULATION OF (p,p') SCATTERING. Agassi, D.; Schaeffer, R. (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). Phys. Lett., 26B: 703-5 (May 13, 1968).

The exchange terms in a microscopic DWBA calculation are found to play an important role for both the cross section and polarization in the case of the collective 3^- level in ^{40}Ca and ^{208}Pb. In particular, they are essential for obtaining good agreement with the experimental cross section. (auth)

32698 VECTOR COUPLING CONSTANT IN NUCLEAR BETA DECAY. Bhalla, C. P. (Kansas State Univ., Manhattan). Progr. Theor. Phys. (Kyoto), 39: 231-3(Jan. 1968).

The vector coupling constant was calculated taking into account the static effects of the finite nuclear size and the atomic screening in the calculation of the Fermi function. Numerical results for the coupling constants and ft values, including radiative corrections, for ^{26m}Al, ^{34}Cl, ^{56}Co, ^{14}O, ^{42}Sc, and ^{46}V are presented. (D.C.W.)

32699 LANDOLT-BOERNSTEIN ZAHLENWERTE UND FUNKTIONEN AUS NATURWISSENSCHAFTEN UND TECHNIK. (Landolt-Boernstein Numerical Data and Functional Relationships in Science and Technology). Collard, H. R.; Elton, L. R. B.; Hofstadter, R. Neue Serie. Gruppe I: Kernphysik und Kerntechnik. Band 2. Kernradien. (New Series. Group I: Nuclear Physics and Technology. Volume 2. Nuclear Radii). Berlin, Springer-Verlag, 1967. 60p. DM 38,-; $9.50.

The information on nuclear radii and other nuclear parameters which has been obtained by electron scattering experiments and by the observation of mesic x rays is surveyed. (D.C.W.)

32700 THEORY OF NEUTRON RESONANCE REACTIONS. Lynn, J. E. Oxford, Clarendon Press, 1968. 518p. 100s.

The subject is treated under the following main headings: formal nuclear reaction theories; the single-particle model of neutron reactions; the spacing of neutron resonances; the statistical distribution of resonance spacings; neutron elastic scattering; radiative capture; and neutron-induced fission. (UK)

32701 PREDICTIONS OF NEW MAGIC REGIONS AND MASSES FOR SUPER-HEAVY NUCLEI FROM CALCULATIONS WITH REALISTIC SHELL MODEL SINGLE PARTICLE HAMILTONIANS. Meldner, Heiner. Ark. Fys., 36: 593-8(1967).

The single particle part of a realistic shell model Hamiltonian is considered to contain a nonlocal potential similar to the classic Van Vleck nuclear potential. Using an ansatz for the Hamiltonian suggested by rather general treatments of many-fermion systems it was possible to get a consistent fit to nuclear charge density distributions including isotope effects, 1s proton levels as measured in (e,e'p) scattering, and total binding energies or nuclear mass defects, while reproducing the shell model level sequences, i.e., spin assignments. Extrapolations to nuclei off the stability valley and to super-heavy nuclei appear to be reasonable. In the latter case some evidence was found for a doubly magic nucleus at proton number 114 and neutron number 184 with a total binding energy around 2200 MeV. There is no indication of a doubly magic nucleus with $Z = 126$, $N = 184$ close to the line of beta stability. However, some support was found for a relatively long-lived compound nucleus with these nucleon numbers by investigating metastable proton states. (auth)

32702 ANOMALIES IN NUCLEAR MASSES. Myers, W. D.; Swiatecki, W. J. Ark. Fys., 36: 343-52(1967).

Recently gained insight into the nature of the shell correction to the mass of a nucleus, regarded as a function of nuclear deformation, enables one to understand some of the outstanding anomalous trends in nuclear masses, including the behavior of fission barriers. (auth)

32703 GAMMA-RAY EXCITATION OF NUCLEAR ISOMERS. Abrams, I. A.; Pelekis, L. L. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser., No. 1, 19-27 (1968). (In Russian).

A review of research into the reaction (γ,γ'), which was carried out in the period 1939 to 1967, is presented. The energy range of the bremsstrahlung for some atomic nuclei is indicated, and an analysis of the possibility of excitation of nuclear isomers is concluded. For the atomic nuclei ^{77}Se, ^{89}Y, ^{103}Rh, ^{107}Ag, ^{109}Ag, ^{111}Cd, ^{115}In, ^{197}Au, the cross-section energy dependence of the reaction (γ,γ') and the activation cross section for γ rays of ^{60}Co, ^{116m}In, and ^{182}Ta for isomers ^{77m}Se, ^{89m}Y, ^{87m}Sr, ^{103m}Rh, ^{107m}Ag, ^{109m}Ag, ^{111m}Cd, ^{113m}Cd, ^{113m}In, ^{115m}In, ^{167m}Er, ^{176m}Lu, ^{179m}Hf, ^{191m}Ir, ^{195m}Pt, ^{197m}Au, ^{199m}Hg, are plotted in diagrams and tables. (auth)

32704 PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON NUCLEAR STRUCTURE, TOKYO, SEPTEMBER 7-13, 1967. Sanada, J. (ed.). J. Phys. Soc. Jap., 24: Suppl., 1-755 (1968). (CONF-670910).

The formal proceedings of the conference are presented. Title-list entries and subject indexing for all 418 papers that were submitted for the conference have previously been prepared for NSA using the published contributions (22: 27279). (D.C.W.)

32705 RESONANCE STATES IN NUCLEAR REACTION THEORY. Romo, William Joseph. Madison, Wis., Univ. of Wisconsin, 1967. 204p.
Thesis.

A study was made of a many-channel scattering problem which arises in low-energy nuclear physics. Special attention is paid to the discrete spectrum of states which have outgoing boundary condition, that is the bound states and resonances of the system. Resonance-state wave functions unlike bound state wave functions are badly behaved in the asymptotic region, growing exponentially with particle separation. As a consequence matrix elements involving resonance states can not be defined by the usual prescription. To overcome this difficulty, a generalized definition of matrix elements is introduced. Under the new definition matrix elements involving resonance states are well defined, and futhermore the definition has the desirable feature of reducing to the old definition when one is considering real energy states. It is shown that the set of bound and resonance states form an orthonormal set with respect to the inner product associated with the new prescription. The new formalism is used to extend Mac Donald's nuclear reaction theory in such a way that resonances and bound states of the model system are treated in a unified manner. It is shown that the accuracy of the approximation scheme suggested by Mac Donald for phenomenological analysis of scattering experiments is improved in the extended theory. An alternate approximation scheme is suggested, which is more accurate near channel thresholds. And finally the reaction theory is applied to an idealized scattering process between a neutron and an ^{17}O target. The interactions are selected in such a way that the problem can be solved exactly, thus enabling one to determine the accuracy of the approximation scheme. The results of the approximation scheme are seen to be in excellent agreement with the exact results. (Disser. Abstr.)

32706 NUMERICAL ANALYSIS OF THE 1P SHELL NUCLIDES. Whitson, John Calvin. Clemson, S. C., Clemson Univ., 1967. 64p.
Thesis.

The nuclear shell model calculations previously performed have used harmonic oscillator wave functions for radial wave functions along with a given set of exchange parameters. The results have given reasonable agreement with experiment. This study investigates the effects of wave functions obtained by using a central potential which follows the shape of the nuclear density. The effects of varying the exchange parameters are also investigated in order to choose a set of parameters which will give better agreement with experiment than previous calculations. The parameters obtained for the central potential make possible the use of the results of this investigation in scattering calculations. The j-j coupling scheme was used throughout the calculations. The antisymmetrization of the j-j coupled wave functions is accomplished by using the so called coefficients of fractional parentage. The c.f.p. were numerically calculated using recursion relations. The c.f.p. were then used to construct matrices of spin-orbit and a two-body interaction. The resulting matrices were then diagonalized to give the corrections to the energy obtained by coupling single-particle wave functions. Calculations have been performed for all the 1P shell nucleides where good experimental data exists. A set of exchange parameters has been found which gives better agreement for ^{7}Li then has been previously obtained. This same set of parameters provides good agreement throughout the 1P shell, in particular for ^{12}C, ^{11}B and ^{14}N. ^{7}Li provides the experimental spectrum which is most sensitive to the variation of the exchange parameters. Because of this fact it is believed that the set of exchange parameters obtained for ^{7}Li may provide good agreement in other types of calculations. (Disser. Abstr.)

32707 HIGH ANGULAR MOMENTUM RESONANCES IN NEUTRON CROSS SECTIONS AT LOW ENERGIES. Usmani, Q. N.; Khan, M. Z. R. (Aligarh Muslim Univ., India). pp 112-16 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.
See CONF-670220–(Vol.2).

An attempt was made to investigate the resonances of high angular momentum in neutron cross sections at low energy. Accordingly, the Feshbach, Peaslee, and Weisskopf theory was applied to the scattering of neutrons from a square-well potential. It was found that their expansion of the logarithmic derivative does not converge for high values of angular momentum in the neighborhood of the resonance energies. A modified formalism is proposed. (D.C.W.)

32708 ALPHA PARTICLE SCATTERING. Mehta, M. K. (Bhabha Atomic Research Centre, Trombay, India). pp 131-57 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.
See CONF-670220–(Vol.2).

The use of alpha scattering in the investigation of nuclear phenomena is discussed, including methods for analyzing alpha scattering data. (D.C.W.)

32709 PERTURBED ANGULAR CORRELATIONS. Devare, H. G. (Tata Inst. of Fundamental Research, Bombay). pp 216-31 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.
See CONF-670220–(Vol.2).

A survey of developments, since 1963, in methods for observing and interpreting perturbed angular correlations is presented. The various perturbation mechanisms and their effects on angular correlations are outlined, and some recently developed applications of the technique are discussed. (D.C.W.)

32710 SINGLE NUCLEON TRANSFER REACTION BETWEEN COMPLEX NUCLEI. Suzuki, Takehiko (Tokyo Univ.). Progr. Theor. Phys. (Kyoto), 39: 83-90(Jan. 1968).

Investigations of single nucleon transfer reactions between complex nuclei are made in the quasielastic approximation. Nuclear attraction is taken into account for the transfer reactions at high energies. A simple analytic expression for the differential cross section is obtained which gives two peaks, one at some intermediate angle and the other at $\theta = 0°$. Some features of the forward peak are discussed. The result seems to coincide with the observed angular distribution. (auth)

32711 OPTICAL WELL SCATTERING OF NEUTRONS FROM NUCLEI. Mukherjee, S.; Shastry, C. S. (Saha Inst. of Nuclear Physics, Calcutta). pp 39-48 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.
See CONF-670220–(Vol.2).

The analysis of neutron scattering in terms of Khuri and Regge pole representation is extended to higher energies. Scattering by ^{138}Ba, ^{56}Fe, and ^{48}Ti at 6, 10, and 14 MeV is treated in detail. (D.C.W.)

32712 LOW ENERGY NEUTRON SCATTERING FROM NUCLEI. Mukherjee, S.; Shastry, C. S. (Saha Inst. of Nuclear Physics, Calcutta). pp 28-38 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.
See CONF-670220–(Vol.2).

The optical model is studied in terms of the physics of the system of particles involved in scattering. A Regge-type representation of the scattering amplitude, which is essentially a description of the scattering in terms of poles of the S-matrix in the angular momentum plane, is used. The scattering of neutrons of 0.4 to 4.6 MeV by several nuclei is discussed as an example. (D.C.W.)

32713 PHENOMENOLOGICAL POTENTIALS AND REALISTIC FORCES. Mehta, G. K.; Waghmare, Y. R. (Indian Inst. of Tech., Kanpur). pp 84-91 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.
See CONF-670220–(Vol.2).

An attempt was made to evaluate the parameters of the phenomenological potential using the Yale potential matrix elements. Phenomenological matrix elements were compared with calculated "realistic" matrix elements; the overall agreement was satisfactory, with a discrepancy for p-states arising from the nature of the realistic force. The parameters obtained provide a useful phenomenological force for nuclear structure calculations with harmonic oscillator wave functions. (D.C.W.)

32714 NUCLEAR STRUCTURE STUDIES USING REALISTIC NUCLEON–NUCLEON INTERACTIONS. Waghmare, Yeshwant R. (Indian Inst. of Tech., Kanpur). pp 69-81 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.
See CONF-670220–(Vol.2).

The formulation of realistic nucleon-nucleon potentials for application in calculations of nuclear structure is discussed. The form of the effective interaction for shell-model calculations is considered in detail. (D.C.W.)

32715 OPERATOR DERIVATION OF CERTAIN RECURSION RELATIONS BETWEEN RADIAL MATRIX ELEMENTS OF THE COULOMB FIELD. Kulkarni, R. G.; Swamy, N. V. V. J. (Karnatak Univ., Dharwar, India). pp 64-8 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.
See CONF-670220–(Vol.2).

Pasternack previously derived two different recursion relations between the radial Coulomb expectation values for positive and negative integral powers of γ by using the contiguous relations between the generalized hypergeometric functions. It is shown that the recurring relations can be derived on the basis of operator algebra without recourse to the properties of the contiguous relations of the hypergeometric functions. (D.C.W.)

32716 POTENTIAL MODELS OF NUCLEAR FORCES AT SMALL DISTANCES. Tamagaki, Ryozo (Hokkaido Univ., Sapporo). Progr. Theor. Phys. (Kyoto), 39: 91-107(Jan. 1968).

Recently the small distance behavior of nuclear forces has been brought to light in connection with the interaction of elementary particles and the structure of atomic nuclei. Several potential models are presented, where potentials have the tail of the one-pion-exchange potential (OPEP) and different forms at small distances. Potential parameters representing the medium-range interaction are chosen by taking account of the results obtained by the one-boson-exchange model and the dispersion-theoretic approach. Possible ambiguities at small distances, which can not be resolved from the present experimental information, are discussed.

Also, phenomenological potentials, which can be substituted for such realistic potentials and used conveniently in calculations of finite nuclei, are given in the form of the superposition of three-range Gaussian terms. (auth)

32717 CORE-BREAKING WIDTH IN THE NUCLEAR SHELL MODEL. Wong, S. S. M. (Univ. of Rochester, N. Y. Univ. of Alberta, Edmonton). Nucl. Phys., A113: 233-40(1968).

The amount of core-excited admixture in the low-lying shell-model states is investigated by comparing the width with the energy involved in breaking the core. Numerical results are obtained for the sd shell nuclei and are found to agree well with exact calculations and available data. (auth)

32718 AN EFFECTIVE NUCLEON–NUCLEON POTENTIAL FOR USE IN NUCLEAR HARTREE–FOCK CALCULATIONS. Nestor, C. W. Jr. (Oak Ridge National Lab., Tenn.); Davies, K. T. R.; Krieger, S. J.; Baranger, M. Contract W-7405-eng-26. Nucl. Phys., A113: 14-26(1968). (ORNL-P-3575).

An effective nucleon-nucleon potential for use in nuclear Hartree–Fock calculations has been constructed from a central potential, a velocity-dependent repulsive potential and tensor and spin-orbit potentials. The principal aim of this work was to determine an effective potential having no "hard-core" singularity, giving the correct energy and density of nuclear matter, and fitting the two-body scattering data as well as possible, consistent with good estimates of nuclear matter properties. An additional requirement was that the second-order contribution to the energy of nuclear matter be small in order to improve the convergence of the perturbation expansion. The results presented include the parameters determining a family of potentials, the calculated two-body phase shifts, scattering lengths and effective ranges, the quadrupole moment and percentage of the D-state in the deuteron and a calculated effective single-particle potential. (auth)

32719 DIRECT NUCLEAR REACTIONS AS TESTS OF TIME-REVERSAL INVARIANCE. Henley, E. M.; Huffman, A. H. (Univ. of Washington, Seattle). Phys. Rev. Lett., 20: 1191-4(May 20, 1968).

The percentage violation of reciprocity in the cross sections of direct rearrangement reactions is investigated and is shown to be of the same order of magnitude as the percentage strength of the violating force. (auth)

32720 EFFECTIVE OPERATORS OF ELECTROMAGNETIC INTERACTIONS IN NUCLEI AND REALISTIC NUCLEON–NUCLEON POTENTIALS. Gmitro, M.; Rimini, A.; Sawicki, J.; Weber, T. (IAEA, Trieste, Italy). Phys. Rev. Lett., 20: 1185-8(May 20, 1968).

Electromagnetic interactions in nuclei are described in terms of effective operators for valence (open-shell) nucleons only. The effective operators are calculated theoretically from a realistic nucleon-nucleon potential (Yale-Shakin) in terms of excitations and de-excitations of particle-hole pairs of the core nucleons. The theory is successfully applied to ^{116}Sn whose states are described in terms of the two- and four-quasiparticle Tamm-Dancoff theories involving valence neutrons only. (auth)

32721 SHELL MODEL OF NUCLEAR STRUCTURE. Meyer, Eugene Jr. (Lewis Coll., Lockport, Ill.). Amer. J. Phys., 36: 250-7(Mar. 1968).

The shell model of the nucleus is reviewed as a pure single-particle model emphasizing recent spectroscopic evidence. Qualitative evidence for magic numbers is reconsidered in the light of current data. A partial listing is given for nuclei where spectroscopic evidence points towards shell model structures. (auth)

32722 NUCLEAR MODELS. Elton, L. R. B.; Jackson, Daphne F. (Univ. of Surrey, Eng.). Phys. Educ., 3: 131-8 (May 1968).

The structure and relation of the models used to describe the nuclear many-body problem are discussed in order to illustrate the role of models and model making in the development of physics. (auth) (UK)

32723 NUCLEAR GLORY SCATTERING. Bryant, Howard C. (Univ. of New Mexico, Albuquerque); Jarmie, Nelson. Contract AT(29-1)-789. Ann. Phys. (N.Y), 47: 127-40(1968). (SC-CR-67-2578).

A simple model in terms of surface waves for nuclear backscattering analogous to the optical explanation of the meteorological glory is derived for spin-0 and spin-$^1/_2$ particles from spin-0 targets. Numerous examples of α scattering from spinless nuclei in the energy range from 18 to 50 MeV and π^+ scattering from protons in the range 2 to 8 GeV are fit successfully with the model. The model yields estimates of the radius of interaction whose values are in agreement with radii determined by other means. Other theories and models relating to backscattering are discussed and attention is called to the similarity between the model and the Regge-pole treatment of this problem by Ceuleneer, Demeur, and Reignier. (auth)

32724 NUCLEAR MAGNETIC MOMENTS AND HYPERFINE INTERACTIONS FROM PERTURBED ANGULAR CORRELATIONS. Svensson, Ake G. (Univ., Uppsala). Acta Univ. Upsaliensis, Abstr. Uppsala Diss. Sci., No. 84, 7p(1967).

Experimental investigations of nuclear magnetic moments are reviewed. The work was described in detail in 10 published papers on the following topics: nuclear magnetic moment of the 3.2-MeV state in ^{208}Pb; possible core polarization effects in the magnetic moments of states in ^{207}Pb, magnetic moment of $^9/_2{}^+$ rotational state in ^{175}Lu; magnetic moment of the 139-keV level in ^{192}Ir; the magnetic hyperfine interaction in an Fe–Ir alloy; the 114-keV level in ^{149}Pm; magnetic moment of the $^3/_2{}^+$ state in ^{203}Tl and core excitation; nuclear magnetic moments of 1st and 2nd excited states in ^{127}I; the nuclear g-factor of the 1,301-keV 4$^+$ level in ^{144}Nd; measurements of combined magnetic and electric perturbations on angular correlations of gamma rays from polycrystalline sources; and influence of position annihilation in gamma-gamma coincidence measurements in decay of ^{118}Te and ^{119}Te. (Sweden)

32725 ANALYSES OF NUCLEAR SCATTERING AT INTERMEDIATE ENERGIES. Thompson, William Jackson. Tallahassee, Fla., Florida State Univ., 1967. 218p.

Thesis.

Several analyses of nuclear elastic and inelastic scattering are presented. Formulas for scattering from spin-zero targets are derived. The optical model potential and associated wave-functions are briefly discussed. Application is made to the gamma ray emission in ^{12}C(p,γp$'$)^{12}C below 3 MeV proton energy. Exchange terms in elastic scattering are examined for alpha particle scattering from ^{24}Mg and it is also shown that an exchange potential can be derived. A zero-range exchange potential is examined in detail for proton scattering from ^{45}Sc. The effects of nuclear deformation on elastic and inelastic scattering are illustrated in analyses of ^{24}Mg(α,α)^{24}Mg and ^{19}F(p,p)^{19}F. Finally the extraction of neutron spectroscopic factors for isobaric analog resonances in the presence of background potential scattering is described. Application to ^{90}Zr(p,p$_0$)^{90}Zr between 5 and 7 MeV bombarding energy is made. (Disser. Abstr.)

32726 CONFIGURATION MIXING EFFECTS IN DIRECT REACTIONS. Prakash, Anand. Pittsburgh, Univ. of Pittsburgh, 1966. 100p.

Thesis.

A close examination of the meaning of the form-factor for direct reactions that involve the transfer of a single nucleon shows that the "direct" transfer of a nucleon is a much more complicated process than that suggested by the picture of insertion of the nucleon into a single-particle well. The discussion is done in the framework of an alternative variational derivation of the Pinkston-Satchler equation for the form-factor. The variational method is different from the Hartree–Fock and generalized Hartree–Fock methods. It is seen that the rearrangements of the target nucleons on capture (or pickup) of a nucleon affect the orthogonality of form-factors and necessitate a clear distinction between form-factors and the single-particle wavefunction. Since it would be an impossible task to take exactly into account all the rearrangements, a simplified treatment, in which the core particles are assumed to provide only an average potential, but the extra-core particles are treated individually, can be considered as an accurate treatment of the problem. Taking the average potential to be a phenomenological Saxon-Woods potential, and taking the extra-core wavefunctions from the usual shell-model calculations, a general method for solving the Pinkston–Satchler equation for the form-factor is developed. In this method the equation is converted into a set of linear algebraic equations that contain matrix-elements of the two-body interaction. These matrix-elements are calculated by the "Moshinsky-transformation" technique. The algebraic equations then yield the form-factor. One thus has a unified "structure-stripping" calculation. The method can be regarded as a one-step iteration of the Pinkston-Satchler equations in which the inhomogeneous term is approximated from the shell-model calculation. Such structure-stripping calculations are performed for ^{58}Ni, ^{57}Ni and the resulting form-factors are used to study (p,d) and (d,t) reactions on ^{58}Ni. The residual interaction used is of gaussian shape with a Majorana exchange. In the (p,d) calculations, a good fit is obtained for the hitherto unexplained angular distribution for the $f_{5/2}$ pick-up leading to the 0.78 MeV ($^5/_2{}^-$) state of ^{57}Ni. The ^{58}Ni(d,t)^{57}Ni calculations revealed that spectroscopic factors obtained by using the form-factors of the conventional "well-depth" (or "separation energy") prescription can be in error by as much as 50%. A simpler phenomenological method to generate form-factors (which does not require calculation of matrix elements) is also given. While the conventional well-depth prescription lacks theoretical basis for its use in cases other than stripping on a closed-shell target, the simple method developed here goes beyond stripping on a closed-shell target. The method uses the same Saxon–Woods parameters (V_0, R_0, a, V_{s0}) for calculating all form-factors for transitions between two given nuclei, and, at the same time, ensures a correct tail (governed by the actual separation energy) for each form-factor. This method is of restricted applicability. (Disser. Abstr.)

32727 NUCLEAR LEVELS EXCITED IN NEUTRON CAPTURE REACTIONS AND RADIOACTIVE DECAYS. Baecklin, A. (Univ., Uppsala). Acta Univ. Upsaliensis, Abstr. Uppsala Diss. Sci., No. 96, 8p(1967).
Thesis.

Some investigations of nuclear level structure by measuring conversion electron spectra from neutron capture and by observing beta decay are summarized, together with the development of a double-focusing beta spectrometer for internal conversion electrons. (D.C.W.)

32728 NANOSECOND LIFETIMES OF EXCITED STATES THROUGH NEUTRON INELASTIC SCATTERING WITH INTENSE PULSED BEAMS. Nath, N.; Siddiq, A. K. M.; Murray, G. (Atomic Energy Research Establishment, Harwell, Eng.). pp 530-5 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.
See CONF-670220–(Vol.2).

Many of the low-lying states in the medium and heavy-weight stable nuclei can be favorably excited by neutron inelastic scattering. The gated time-spectrum shows peaks due to gamma-rays following inelastic scattering in a given sample as well as neutrons scattered into a scintillation detector kept at a suitable distance from the sample. By selecting a narrow gate in the energy spectrum due to a particular gamma ray, the time distribution was studied with respect to individual machine pulses. The relevant experimental technique is outlined. Experimental data on the measurement of mean lifetimes of the 0.58-MeV state in ^{25}Mg and the 1.14-MeV state in ^{121}Sb are presented. (auth)

32729 A SURVEY OF RESULTS OF (n,p) CROSS SECTIONS OF 14-MeV NEUTRONS IN LOW-Z NUCLEI. Mitra, B. (Bose Inst., Calcutta). pp 367-73 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.
See CONF-670220–(Vol.2).

The results of some measurements of the (n,p) cross sections for Z = 8 to 33 nuclei were compared with semi-empirical predictions. It was concluded that semi-empirical theories based on the statistical model and taking into account pairing energy and structure effects due to shell closure do not adequately account for the experimental observations. (D.C.W.)

32730 STOCHASTIC THEORY OF FISSION. Ramanna, R.; Ramamurthy, V. S. (Bhabha Atomic Research Centre, Trombay India). pp 310-17 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.
See CONF-670220–(Vol.2).

Further investigations on the stochastic theory of fission are presented. The process of division of the fissioning nucleus into two fragments is represented by a growing energy barrier for nucleon exchange between the two parts, as the nucleus moves towards the scission point. On the basis of the above picture, the elements of the transition matrix representing the process are evaluated, making use of ground-state nuclear properties, with suitable extrapolation to neutron-rich fission fragments. The implications of the parameters used are discussed. (auth)

32731 PRECOMPOUND AND COMPOUND PARTICLES OF DECAY IN NUCLEAR REACTIONS. Kondaiah, E.; Parthasaradhi, K.; Sastry, V. V. G. (Andhra Univ., Waltair, India). pp 286-91 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.
See CONF-670220–(Vol.2).

The experimental data reported in current literature is analyzed using the "exciton" model recently put forth by J. J. Griffin. It appears that precompound particles are dominant in various reactions induced by protons as well as neutrons, especially in the case of low-mass targets. (auth)

32732 SPIN ORBIT INTERACTION AND REGIONS OF DEFORMED NUCLEI. Parikh, J. C. (Tata Inst. of Fundamental Research, Bombay); Bhatt, K. H. pp 266-71 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Nuclear Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.
See CONF-670220–(Vol.2).

It is suggested that a nucleus will be deformed if the energy sequence of the spherical single-particle energy levels, as determined by the spin-orbit interaction, is such as to allow the formation of deformed single-particle orbits having a large intrinsic quadrupole moment. (auth)

REACTOR TECHNOLOGY

Central Power Reactors

Refer also to abstracts 30689, 31390, 31413, and 31526.

32733 (ANL–7310) REACTOR PHYSICS DIVISION ANNUAL REPORT, JULY 1, 1966–JUNE 30, 1967. (Argonne National Lab., Ill.). Jan. 1968. Contract W-31-109-eng-38. 537p. Dep. CFSTI.

Separate abstracts are prepared for the seven different sections. These are: Fission Properties and Cross Section Data; Thermal Reactor Physics including critical experiments on the EBWR and AARR; Fast Reactor Physics including uranium and oxide fuel critical experiments, sodium voiding effects, and Doppler effect measurements; Fast Reactor Safety; Experimental Physics Techniques and Facilities; Reactor Computation Methods and Theory; and Miscellaneous including nuclear pumping of lasers and plasma experiments. 731 references. (M.L.S.)

For abstracts of individual sections see: 32734, 32735, 32959–32961, 33086, and 33087.

32734 (ANL–7310, pp 137-248) FAST REACTOR PHYSICS. (Argonne National Lab., Ill.).

URANIUM ISOTOPES U-238—neutron cross sections for, calculated effects of reactor environment on absorption; fission densities in, sodium void effects on absolute; neutron capture densities in, sodium void effects on absolute; reactivity measurements in ZPR-9 assemblies 11 and 12; reactivity worth determination in ZPR-3

NEUTRON CROSS SECTIONS—calculation of uranium-238 absorption, effects of reactor environment on

CRITICAL ASSEMBLIES—reactivity effects of uranium-238 on fast, comparison of measured and calculated; reactivity worths and expansion effects in fast ZPR-6, measurement of; neutron flux spectra in ZPR-6 and ZPR-9, comparison of real and adjoint; Doppler effect measurements in ZPR-6 and ZPR-9; reactor dimensions and material compositions of fast ZPR-9 assemblies 12-17; Doppler reactivity measurements in fast ZPR-9 assemblies 13-17; critical mass determination for large uranium carbide fast ZPR-6; fuel loading patterns for uranium carbide fast ZPR-6; core for fast ZPR-6, heterogeneity effects on; fuel loading in uranium carbide fast ZPR-6, absolute fission rates for bunched and unbunched uranium-238 in; core for fast ZPR-6, sodium void effects on absolute fission densities in uranium-238 and uranium-235 and capture density in uranium-238; sodium void coefficient measurements for large uranium carbide fast ZPR-6; sodium void coefficients for ZPR-6, effect of reactor environment and loading pattern on; reactivity measurements in large uranium carbide fast ZPR-6, temperature effects on; cores for ZPR-6 and ZPR-9, measurement of central fission ratio in; core for ZPR-6, measurement of fission neutron density in; design parameters for ZPR-9 assemblies 11 and 12; cores for ZPR-6 and ZPR-9, comparison of calculated real and adjoint fluxed at centerline of; Doppler effect measurements in ZPR-9 assemblies 11 and 12; cores for ZPR-6, neutron spectrum comparisons for zoned and homogeneous fast; sodium void reactivity calculations for ZPR-6, heterogeneity effects on; neutron die-away experiments in ZPR-6, tabulation of results from; reactivity measurements in ZPR-6, pulsed neutron techniques for; neutron decay constant measurements in ZPR-6, use of pulsed neutron technique for prompt; reflectors for fast ZPR-3, savings properties of inconel-sodium; core for ZPR-3, symmetry effects of embedded reflectors in blanket around; reactivity worth of, relation of reciprocal flux to; reactivity worths in ZPR-3, comparison of measured and calculated; plutonium fission rates in, calculation of

REACTIVITY—effects of uranium-238 on fast critical assemblies, comparison of measured and calculated; effects of fissile material expansion in fast reactors, calculational procedure for determining; measurements in fast ZPR-9 assemblies 13-17, effects of temperature on; measurements in ZPR-6, pulsed neutron techniques for; determinations for fast converter reactors, effects of sodium voiding on

URANIUM OXIDES UO_2—fuel pellets of, temperature effects on radial expansion of axial constrained

URANIUM ISOTOPES U-235—expansion effects on fast ZPR-6 reactivity; fission densities in, sodium void effects on absolute; reactivity measurements in ZPR-9 assemblies 11 and 12; reactivity worth determination in ZPR-3

MOLYBDENUM—Doppler effect measurements in ZPR-9 assemblies 12-17; reactivity measurements in large uranium carbide fast ZPR-6; reactivity measurements in ZPR-9 assemblies 11 and 12; reactivity worth determination in ZPR-3

TUNGSTEN—reactivity measurements in large uranium carbide fast ZPR-6; reactivity measurements in ZPR-9 assemblies 11 and 12; Doppler effect measurements in ZPR-9 assemblies 12-17

NICKEL—Doppler effect measurements in ZPR-9 assemblies 12-17; reactivity measurements in large uranium carbide fast ZPR-6; reactivity measurements in ZPR-9 assemblies 11 and 12; reactivity worth determination in ZPR-3

TANTALUM—Doppler effect measurements in ZPR-9 assemblies 12-17; reactivity measurements in large uranium carbide fast ZPR-6; reactivity measurements in ZPR-9 assemblies 11 and 12; reactivity worth determination in ZPR-3

IRON—Doppler effect measurements in ZPR-9 assemblies 12-17; reactivity measurements in large uranium carbide ZPR-6; reactivity worth determination in ZPR-3

CARBON—Doppler effect measurements in ZPR-9 assemblies 12-17; reactivity measurements in large uranium carbide fast ZPR-6; reactivity measurements in ZPR-9 assemblies 11 and 12; reactivity worth determination in ZPR-3

BORON—Doppler effect measurements in ZPR-9 assemblies 12-17

STAINLESS STEEL—Doppler effect measurements in ZPR-9 assemblies 12-17; reactivity measurement in large uranium carbide ZPR-6 on Type-304; reactivity measurements in ZPR-9 assemblies 11 and 12 on Type 304; reactivity worth determination in ZPR-3 of Type 304

ALUMINUM—Doppler effect measurements in ZPR-9 assemblies 12-17; reactivity measurements in large uranium carbide fast ZPR-6; reactivity measurements in ZPR-9 assemblies 11 and 12; reactivity worth determination in ZPR-3

BERYLLIUM—Doppler effect measurements in ZPR-9 assemblies 12-17; reactivity measurements in large uranium carbide fast ZPR-6; reactivity measurements in ZPR-9 assemblies 11 and 12

ETHYLENE POLYMERS—Doppler effect measurements in ZPR-9 assemblies 12-17; reactivity measurements in large uranium carbide fast ZPR-6; reactivity measurements in ZPR-9 assemblies 11 and 12

SODIUM—Doppler effect measurements in ZPR-9 assemblies 12-17; reactivity measurements in large uranium carbide ZPR-6; reactivity measurements in ZPR-9 assemblies 11 and 12; reactivity worth determination in ZPR-3

PLUTONIUM—Doppler effect measurements in ZPR-9 assemblies 12-17; reactivity measurements in large uranium carbide ZPR-6; reactivity measurements in ZPR-9 assemblies 11 and 12

URANIUM—Doppler effect measurements in ZPR-9 assemblies 12-17 on enriched and depleted

BORON ISOTOPES B-10—reactivity measurements in large uranium carbide fast ZPR-6; reactivity measurements in ZPR-9 assemblies 11 and 12; reactivity worth determination in ZPR-3

VANADIUM—reactivity measurements in large uranium carbide fast ZPR-6; reactivity measurements in ZPR-9 assemblies 11 and 12

LITHIUM—reactivity measurements in large uranium carbide fast ZPR-6; reactivity measurements in ZPR-9 assemblies 11 and 12

ZIRCONIUM—reactivity measurements in large uranium carbide fast ZPR-6; reactivity measurements in ZPR-9 assemblies assemblies 11 and 12

BORON CARBIDES—reactivity measurements in large uranium carbide fast ZPR-6; reactivity measurements in ZPR-9 assemblies 11 and 12

NIOBIUM—reactivity measurements in large uranium carbide fast ZPR-6; reactivity measurements in ZPR-9 assemblies 11 and 12

CHROMIUM—reactivity measurements in large uranium carbide ZPR-6; reactivity worth determination in ZPR-3

URANIUM ISOTOPES U-233—reactivity measurements in large uranium carbide ZPR-6; reactivity measurements in ZPR-9 assemblies 11 and 12

IRON OXIDES Fe_2O_3—reactivity measurements in large uranium carbide ZPR-6

RHENIUM—reactivity measurements in large uranium carbide ZPR-6

ZIRCONIUM HYDRIDES—reactivity measurements in large uranium carbide ZPR-6

TITANIUM—reactivity measurements in large uranium carbide ZPR-6

HAFNIUM—reactivity measurements in large uranium carbide ZPR-6

EUROPIUM—reactivity measurements in large uranium carbide ZPR-6
PLUTONIUM ISOTOPES Pu-239—reactivity worth determination in ZPR-3
PLUTONIUM ISOTOPES Pu-240—reactivity worth determination in ZPR-3
OXYGEN—reactivity worth determination in ZPR-3
NUCLEAR POWER PLANTS—fuel cycle performance estimates for oxide-fueled
REACTORS, FAST—sodium void effects in single-zone breeder, flux synthesis method for calculating; sodium void reactivity calculations for, effects of zone enrichment on; physics parameters for plutonium oxide fueled breeder; physics parameters for uranium-235 oxide fueled converter; sodium voiding in converter, effects on reactivity of; fuel cycle costs for converter
REACTORS, BREEDER—sodium void effects in single-zone fast, flux synthesis method for calculating; sodium void reactivity calculations for, effects of zone enrichment on; physics parameters for plutonium oxide fueled fast
EXPERIMENTAL BREEDER REACTOR-II—neutron flux spectra for, adjoint and real; reactivity measurements in, effects of core region on; temperature coefficients in; neutron flux values in, effects of reactor environment on (M.L.S.)

32735 (ANL-7310, pp 249-375) FAST REACTOR SAFETY. (Argonne National Lab., Ill.).

REACTOR SAFETY EXPERIMENTS—fuel element testing in TREAT, effects of flowing sodium on EBR-2 Mark I; fuel element testing in, radiation and transient effects on partial-burnup fast oxide; neutron hodoscope for TREAT, circuit diagrams for amplifier discriminator boards for fast; fuel meltdown loop for TREAT, description of instrumentation for sodium; pumps for TREAT sodium loop, development of annular linear induction; core for TREAT, fission neutron density ratios and neutron flux lethargy distributions in; core for TREAT, physics parameters for thermal-to-fast converters for; temperature coefficient for, analytical determination of; sodium coolant for TREAT, hydrodynamics equations for; coolant temperature profiles in TREAT, effects of oxide and carbide fuel power transients on; sodium vapor void fraction profiles in TREAT, effects of oxide and carbide fuel power transients on; sodium coolant flow coastdown transients in TREAT, analysis of
EXPERIMENTAL BREEDER REACTOR-II—fuel elements for, radiation testing in TREAT of
REACTOR FUEL ELEMENTS—radiation effects on EBR-2 pin-type, TREAT testing of; radiation effects on pin-type, safety analysis of effects of flowing sodium and; accident behavior of argon-bonded pin-type, TREAT testing of; physical properties of oxide fast, radiation effects on; radiation effects on fast oxide, metallographic analyses of; radiation effects on partial-burnup fast oxide, metallographic analyses of; meltdown in TREAT of, fast neutron hodoscope for determination of; heat transfer characteristics of fast ceramic, effects of reactor transients on; deformation of fast, analysis of
GLOVE BOXES—design for TREAT; sodium extruder for inert atmosphere, description of remotely operated
NEUTRONS, FAST—hodoscope for TREAT facility, circuit diagrams for amplifier discriminator boards for
HODOSCOPES—design of high resolution TREAT, for fast neutron detection
RADIATION DETECTORS SCINTILLATION—design of high resolution hodoscopic
PUMPS (LIQUID METAL)—performance data for annular linear induction, (ALIP)
ELECTROMAGNETIC PUMPS—performance data for annular linear induction, (ALIP)
REACTORS, FAST—sodium boiling accidents in, theoretical analysis of response during; reactivity coefficients for, determination of feedback; fuels for, effects of reactor transients on heat transfer characteristics of ceramic; fuel elements for, analysis of deformation of; stability of, safety analysis of effects of reactivity feedback on; excursions in, qualitative analysis of effects of shock wave-induced
REACTIVITY—feedback coefficients for fast reactor, analysis of; effects on stability of fast reactors, safety analysis of feedback
LITHIUM—phase properties of, determination of; equations of state for, constants
SODIUM—phase properties of, determination of; equations of state for, constants for
POTASSIUM—phase properties of, determination of; equations of state for, constants
RUBIDIUM—phase properties of, determination of
CESIUM—phase properties of, determination of
URANIUM—equations of state for, constants for
URANIUM OXIDES UO_2—equations of state for, constants for
URANIUM CARBIDES—equations of state for, constants for; linear expansion coefficients for
PLUTONIUM—equations of state for, constants for
TUNGSTEN—equations of state for, constants for
TANTALUM—equations of state for, constants for
ALUMINUM—equations of state for, constants for
MERCURY—equations of state for, constants for
SODIUM CHLORIDES—equations of state for, constants for
SILICON OXIDES—equations of state for, constants for
BERYLLIUM OXIDES—equations of state for, constants for
MAGNESIUM OXIDES—equations of state for, constants for
GRAPHITE—linear expansion coefficients for
TANTALUM CARBIDES—linear expansion coefficients
REACTOR CONTAINMENT SYSTEMS—leakage rates for, comparison of methods for determining
ROCKET REACTORS (KIWI)—energy yield from transient nuclear tests (KIWI-TNT), use of Bethe-Tait method for calculation of
REACTOR SAFETY—core test facility for analyses for, description of proposed; shock wave-induced excursion in fast, analysis of effects of (M.L.S.)

32736 (ANL-Trans-588) PROBLEMS OF THE CONSTRUCTION OF A HIGH POWERED FAST REACTOR. Leipunskii, A. I.; Orlov, V. V.; Pinkhasik, M. S.; Troyanov, M. F.; Rineiskii, A. A. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from paper presented at IAEA International Working Group on Fast Reactors Meeting, Vienna, Austria, March 5-7, 1968. 18p. (CONF-680316-1). Dep. CFSTI.

The design parameters for the BN-350 reactor are presented and compared to design parameters for high power fast reactors of 500 to 1000 MW(e). Design and construction problems described for 500 to 1000 MW(e) fast reactors include: fuel and fuel elements; core and shields; heat transfer system; refueling; liquid sodium pumps; and steam generators. 17 references are included. (D.C.C.)

32737 (APDA-198) MARS: A TWO-DIMENSIONAL EXCURSION CODE. Hirakawa, N. (Edison Electric Inst., New York). June 1967. 71p. Dep. CFSTI.

A two-dimensional excursion code for calculating the maximum hypothetical accident in a PuO_2-UO_2 core for the Fermi Fast Breeder Reactor is described. The MARS code is used to carry out explosion calculations on a cylindrical core which is separated into as many as six annular regions, each having different material properties. (H.D.R.)

32738 (APDA-CFE-19) COMPILATION OF CURRENT TECHNICAL EXPERIENCE AT ENRICO FERMI ATOMIC POWER PLANT, FEBRUARY 1968. Costello, R. H. (Atomic Power Development Associates, Inc., Detroit, Mich. Power Reactor Development Co., Detroit, Mich. Detroit Edison Co., Mich.). May 1968. Contract AT(11-1)-865. 32p. Dep. CFSTI.

The development of special devices for removing the object from the reactor through the 14-inch sodium inlet line was completed. Testing in the 14-inch pipe and reactor mock-up demonstrated that the special devices could remove the object from the reactor core inlet plenum through the 14-inch pipe. Preparations were completed for proceeding with the penetration of the 14-inch pipe elbow of the No. 1 primary loop and the removal of the object. Various approaches for removal of the remaining five zirconium segments from the conical flow guide were investigated, with emphasis on first removing the fastening screws. The organization of the engineering effort for removal of the remaining five zirconium segments was initiated. Spherical mirror images of a few of the holddown fingers were photographed, but the pictures were of poor quality and, as a result, were inadequate to establish the condition of the fingers. Insufficient illumination and difficulty in properly orienting the mirror were the principal obstacles to a successful observation. In an attempt to remove the spherical mirror assembly from the reactor, the mirror and its mounting broke off the support post and fell to the top support plate. Preoperational testing of the exit port inspection facility was continued with effort being concentrated on the gripper, hoist, and associated mechanisms. The need for modifications was shown. Erection and assembly of the FARB section of the new fuel transfer facility was started. The results of metallographic examinations of subassembly specimens at BMI indicated that significant coolant flow blockage occurred in subassembly M122, which adjoined the melted subassemblies M098 and M127 in the reactor. (auth)

32739 (APDA-NTS-18) CALIBRATION MEASUREMENTS OF CONTROL AND SAFETY RODS IN THE ENRICO FERMI REAC-

TOR. Mueller, R. E.; Branyan, C. E. (Atomic Power Development Associates, Inc., Detroit, Mich.). Apr. 1968. 59p. Dep.

The control and safety rod calibration measurements made during the low-power testing of the Enrico Fermi reactor are presented. These measurements were made to confirm the rod design and also to investigate different calibration techniques. Accurate calibrations were obtained over the full length of rod travel for various degrees of shadowing by adjacent rods. Positive period, negative period, subcritical count rate, and intercalibration techniques are described. The results are compared with critical experiment data. Means by which the calibration procedure could be improved are discussed. (auth)

32740 (BAW–3647-7) PHYSICS VERIFICATION PROGRAM. PART II. Final Report. Baldwin, M. N.; Clark, R. H.; Rogers, J. E. (Babcock and Wilcox Co., Lynchburg, Va. Research and Development Div.). Apr. 1968. Contract AT(30-1)-3647. 123p. Dep. CFSTI.

CRITICAL ASSEMBLIES—description of B & W Critical Experiment Laboratory uranium oxide (UO_2)-fueled water-moderated multi-rod
CRITICAL STUDIES—reactivity measurements for aluminum-clad uranium oxide (UO_2) multi-rod water-moderated, analysis of
REACTOR FUEL ELEMENTS—assemblies of aluminum-clad uranium oxide (UO_2), criticality of multi-rod circular
RADIATION DETECTORS, PROPORTIONAL—calibration of B & W Critical Experiment Laboratory multi-rod critical assembly, description of
RADIATION DETECTORS, FISSION CHAMBER, RADIATION DETECTORS, IONIZATION CHAMBER—calibration of B & W Critical Experiment Laboratory multi-rod critical assembly, description of
NEUTRONS—radiation measurement of, effects of concrete shielding thickness on B & W Critical Experiment Laboratory multi-rod critical assembly
REACTIVITY—measurement of aluminum-clad uranium oxide (UO_2) multi-rod water-moderated critical assembly, analysis of
RADIATION DETECTORS, ACTIVATION—measurement of neutron flux distribution in aluminum-clad uranium oxide (UO_2) multi-rod water-moderated critical assembly, analysis of; design of rhodium wire, description of; performance of rhodium wire, description of; calibration of aluminum–dysprosium wire, description of; performance of aluminum–dysprosium wire, description of
RHODIUM—use for neutron flux measurement, description of
ALUMINUM ALLOYS AND SYSTEMS—Al–Dy, use for neutron flux measurement, description of; Al–Cd–In, control rod reactivity worth measurements for, description of
REACTOR CONTROL ELEMENTS—reactivity worth of aluminum–cadmium–indium, measurement of (D.C.C.)

32741 (BNWL–532, pp 3.1-17) EBR-II NEUTRON SPECTRA FROM FOIL DATA AND CALCULATIONS. Rossin, A. D. (Argonne National Lab., Ill.).

The computer program, EBR-II History, is described. The program is written in Fortran IV for the CDC 3600. The program is used to calculate decay corrections so that foils may be analyzed or burnups can be calculated from fission product activity. Results of ^{54}Fe and ^{54}Mn activation rate at 1MW power as a function of core radius are presented. Summary of EBR-II foil data with calculated neutron spectra is presented. The effects of irradiation on the mechanical properties of V-base alloys are described. Both the tensile and yield strength at 550°C of V–20 wt % Ti and V–15 wt % Ti–7.5 wt % Cr increased with fluence due to irradiation in the temperature range of 510 to 704°C to a nominal fluence of 5×10^{21}. Effects on ductility and burst strength are summarized. (D.C.C.)

32742 (BNWL–738) REVIEW OF PHYSICS METHODS USED FOR COMPUTING THE KINETIC BEHAVIOR OF LARGE POWER REACTORS. Carter, N. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jan. 1968. Contract AT(45-1)-1830. 106p. Dep. CFSTI.

The status of the technology for theoretically predicting the neutron kinetic behavior of large power reactors is presented. The need for developing analytical techniques capable of predicting both the spatial and temporal behavior of a large reactor is pointed out. The various techniques which have been developed are described in detail and their relative effectiveness evaluated. The problem of Xe instability is also discussed along with the methods of solution. Computer codes which have been developed to date are listed. 123 references are included. (auth)

32743 (BNWL–739) PLUTONIUM UTILIZATION PROGRAM. Technical Activities Quarterly Report, December 1967–February 1968. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 1968. Contract AT(45-1)-1830. 84p. Dep. CFSTI.

PLUTONIUM RECYCLE TEST REACTOR—fuel burnup of, analysis of radiation effects in; operation during December 1967 to February 1968, description of
REACTOR FUEL ELEMENTS—burnup of PRTR plutonium oxide (PuO_2)–uranium oxide (UO_2) pellet-type, analysis of radiation effects in; burnup of EBWR plutonium oxide (PuO_2)–uranium oxide, gamma scan analysis of; physics measurements for PCTR light water-moderated plutonium oxide (PuO_2)–uranium oxide (UO_2), description of
PLUTONIUM OXIDES PuO_2—PuO_2–UO_2, radiation effects on, analysis of neutron; PuO_2–UO_2, fuel loading for PRCF reactor of, physics measurements for critical, (E/T)
NEUTRONS—effects on microstructure of plutonium oxide (PuO_2)–uranium oxide (UO_2), analysis of
AUTORADIOGRAPHY—use for analysis of radiation effects in plutonium oxide (PuO_2)–uranium oxide (UO_2) pellet-type fuel elements
PHOTOMICROGRAPHY—use for analysis of radiation effects in plutonium oxide (PuO_2)–uranium oxide (UO_2) pellet-type fuel elements
RUTHENIUM-103—distribution in irradiated PRTR plutonium oxide (PuO_2)–uranium oxide (UO_2) pellet-type fuel elements of, analysis of
CRITICALITY STUDIES—measurement of plutonium oxide (PuO_2)–uranium oxide (UO_2), effects of plutonium enrichment on, (E/T)
EXPERIMENTAL BOILING WATER REACTOR—fuel element burnup in, gamma scan analysis of
REACTIVITY—measurement of PRCF uranium oxide (UO_2)-fueled core excess, analysis of; measurement of effects of boron concentration in water on TTR, analysis of, (E/T)
PLUTONIUM RECYCLE CRITICAL FACILITY—core loading for, reactivity measurements for uranium oxide (UO_2) and plutonium oxide (PuO_2)–uranium oxide (UO_2),
URANIUM OXIDES UO_2—fuel loading for PRCF reactor of, physics measurements for critical, (E/T)
PHYSICAL CONSTANTS TESTING REACTOR—fuel cell configuration for, description of light water-moderated plutonium oxide (PuO_2)–uranium oxide (UO_2)
SAVANNAH RIVER THERMAL TEST REACTOR—reactivity in, effects of boron concentration in water on, (E/T)
BENEZENEBORONIC ACID—effects on reactivity of TTR, analysis of, (E/T) (D.L.C.)

32744 (BNWL-SA–668) FISSION PRODUCT AEROSOL BEHAVIOR IN THE PRTR FUEL ROD FAILURE OF SEPTEMBER 29, 1965. Perkins, R. W.; Thomas, C. W.; Silker, W. B. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Nov. 22, 1965. Contract AT(45-1)-1830. 54p. Dep. CFSTI.

On September 29, 1965, at 0510 a purposely defected, partially molten fuel rod in the rupture loop test facility of the PRTR reactor failed in an unexpected manner. The rupture which resulted in a loss of about 39% of the UO_2–PuO_2 fuel from the rod was accompanied by the formation of a hole of approximately ½ inch diameter in the surrounding process tube. The subsequent flashing of the highly contaminated superheated water, released a fission product aerosol to the containment vessel atmosphere. This release resulted in about half of the noble gases reaching the containment vessel atmosphere. About 1 percent of the radioiodine and a somewhat smaller fraction of the solid fission products entered the containment vessel atmosphere. A subsequent radiochemical study provided detailed information on the behavior of some 15 fission products and of plutonium in their movement, following the rod failure, through the various liquid and gaseous systems of the reactor and its containment vessel. The ratios of the fission products (other than the noble gases) which were released to the containment vessel atmosphere were not far different from those in the fuel rod showing that relatively little fractionation occurred in the processes of dissolution and aerosol formation. Only a small fraction of the ^{131}I and other fission products, which were released to the containment vessel atmosphere, were deposited on the containment vessel surfaces. About 99% of the fission product aerosol was removed in the condensate from air coolers which processed about 6 percent of the containment vessel's atmosphere per minute. The ratios of the solid fission products which were deposited on surfaces in the containment vessel were quite similar to those in the fuel rod. ^{141}Ce and ^{95}Zr–^{95}Nb were often exceptions, running several fold lower on the surfaces. The ratio of radioiodine to other fission products was about ten-fold higher on the walls and ceilings than on floor surfaces on the first two days following the incident but after six days the ratios were comparable. The deposition per unit of surface area of the radioactive aerosol was about 4 to 5 times greater on the floors than on wall or ceiling surfaces. The observed deposition per unit area on metal surfaces was much higher than on painted surfaces. Much of the behavior of the radionuclides in this system was similar to what might be expected in the melt-down of any water cooled reactor and the information gained from the study should be applicable to the design of safeguards for such events. (auth)

32745 (CYAP-105) CONNECTICUT YANKEE ATOMIC POWER COMPANY REACTOR CONTAINMENT LEAKAGE RATE TESTS. Tarnuzzer, E. C. (Connecticut Yankee Atomic Power Co., Boston, Mass.). May 1967. 45p.

A strength test at 46 psig, a leakage rate test at 40 psig (the design pressure), and a leakage rate test at 15 psig (the re-test pressure) were performed on the primary plant containment structure of the Connecticut Yankee Atomic Power Company plant at Haddam, Connecticut, prior to plant licensing in May 1967. Welded seams, welded penetrations, gasketed penetrations, and pipe lines were all individually leak tested and repaired where necessary prior to the integrated testing to ensure that the licensing limit on containment leakage of 0.25% per day would be met. The preliminary local testing and preparations for and excution of the integrated tests are described. (auth)

32746 (DOCKET-5016-1) [ENRICO FERMI FAST BREEDER REACTOR]. Provisional Operating License No. DPR-9, Amendment 3. (Power Reactor Development Co., [Detroit, Mich.]). Aug. 1, 1966. 8p. Dep. CFSTI.

An authorization for increase in maximum activity of the gamma ray emitting components of the Fermi Fast Breeder Reactor neutron source is given. The DRL safety evaluation is included. (M.L.S.)

32747 (DOCKET-5016-2) [ENRICO FERMI FAST BREEDER REACTOR]. Provisional Operating License No. DPR-9, Amendment 4. (Power Reactor Development Co., [Detroit, Mich.]). Nov. 4, 1966. 8p. Dep. CFSTI.

The authorization is given allowing the Power Reactor Development Company, owners of the Fermi Fast Breeder Reactor, to receive, possess, and store, but not to use in the reactor, additional quantities of special nuclear and source material in the form of certain sealed test fuel specimens. Fuel quantities are specified; a safety evaluation is given. (M.L.S.)

32748 (DOCKET-50267-3) FORT ST. VRAIN NUCLEAR GENERATING STATION, [UNIT 1]. [Preliminary Safety Analysis Report], Amendment 12. (Public Service Co. of Colorado, Denver). May 8, 1968. 42p. Dep. CFSTI.

The Annual Report of the Public Service Company of Colorado, owners of Fort St. Vrain Power Reactor, for 1967 is presented. An updated list of Directors and Principal Officers is included. An estimated schedule of construction expenditures is given. (M.L.S.)

32749 (DOCKET-50280-17) SURRY POWER STATION, UNITS 1 AND 2. Safety Evaluation by the Division of Reactor Licensing, U. S. Atomic Energy Commission. (Virginia Electric and Power Co., Richmond). May 2, 1968. 90p. (DOCKET-50281-17). Dep. CFSTI.

A complete safety evaluation of Surry Power Reactor, Units 1 and 2, is given. The evaluation is performed by the AEC, Division of Reactor Licensing, and includes a general discussion of plant features, important safety considerations, accident analyses, quality control, station design with respect to the 70 general design criteria, research and development, ACRS report, technical qualifications, and common defense and security. (M.L.S.)

32750 (DOCKET-50295-1) ZION STATION, [UNITS 1 AND 2]. Preliminary Safety Analysis Report, Vol. 1. (Commonwealth Edison Co., Chicago, Ill.). July 12, 1967. 267p. (DOCKET-50304-1). Dep. CFSTI.

Information on the Zion Power Reactor, Units 1 and 2, is given under the following topics: Summary Description; Site and Environment; Reactor; Reactor Coolant System; and Containment System. (M.L.S.)

32751 (DOCKET-50295-2) ZION STATION, [UNITS 1 AND 2]. Preliminary Safety Analysis Report, Vol. 2. (Commonwealth Edison Co., Chicago, Ill.). July 12, 1967. 379p. (DOCKET-50304-2). Dep. CFSTI.

Information on Zion Power Reactor, Units 1 and 2, is presented under the following topics: Engineered Safeguards including the safety injection system, containment spray, containment ventilation system, containment isolation system, isolation valve seal water system, and containment penetration and weld channel pressurization system; plant instrumentation and control; electrical systems; auxiliary and emergency systems; steam and power conversion system; radioactive wastes and radiation protection; conduct of operations; and safety evaluation. Appendices contain five-year stability data (WINDIF) for Chicago and Milwaukee and geological and seismological environmental studies. (M.L.S.)

32752 (DOCKET-50295-3) [ZION STATION, UNITS 1 AND 2]. [Preliminary Safety Analysis Report], Amendment 1. (Commonwealth Edison Co., Chicago, Ill.). Aug. 15, 1967. 147p. (DOCKET-50304-3). Dep. CFSTI.

The application for construction permit for Zion Power Reactor, Units 1 and 2 is given. Revised pages for the original PSAR are included. (M.L.S.)

32753 (DOCKET-50295-4) [ZION STATION, UNITS 1 AND 2]. [Preliminary Safety Analysis Report], Amendment 2. (Commonwealth Edison Co., Chicago, Ill.). Nov. 28, 1967. 78p. (DOCKET-50304-4). Dep. CFSTI.

Revised information on the Zion Power Reactor, Units 1 and 2, is presented for: the summary description, site and environment, reactor, reactor coolant system, and containment system. (M.L.S.)

32754 (DOCKET-50295-5) [ZION STATION, UNITS 1 AND 2]. [Preliminary Safety Analysis Report], Amendment 3. (Commonwealth Edison Co., Chicago, Ill.). Dec. 20, 1967. 76p. (DOCKET-50304-5). Dep. CFSTI.

Information for the Zion Power Reactor, Units 1 and 2, is presented on seismic and design criteria, containment design, and quality assurance. Some revised PSAR pages are included, also. (M.L.S.)

32755 (DOCKET-50295-6) ZION STATION, [UNITS 1 AND 2]. Preliminary Safety Analysis Report, Amendment 4. (Commonwealth Edison Co., Chicago, Ill.). Jan. 29, 1968. 120p. (DOCKET-50304-6). Dep. CFSTI.

Revised information for Zion Power Reactor, Units 1 and 2, is given on the engineered safeguards system, plant instrumentation and control, electrical systems, and auxiliary and emergency systems. The in-service surveillance program for the tendons in the prestressed concrete containment structure is described. (M.L.S.)

32756 (DOCKET-50295-7) [ZION STATION, UNITS 1 AND 2]. [Preliminary Safety Analysis Report], Amendment 6. (Commonwealth Edison Co., Chicago, Ill.). Apr. 4, 1968. 17p. (DOCKET-50304-7). Dep. CFSTI.

Containment instrumentation information for Zion Power Reactor, Units 1 and 2, is given. Operator training programs are outlined. Quality assurance procedures are described. (M.L.S.)

32757 (DOCKET-50295-8) [ZION STATION, UNITS 1 AND 2]. [Preliminary Safety Analysis Report], Amendment 7. (Commonwealth Edison Co., Chicago, Ill.). Apr. 17, 1968. 58p. (DOCKET-50304-8). Dep. CFSTI.

Revised information on the containment system for the Zion Power Reactor, Units 1 and 2, is given; offsite exposure doses resulting from loss-of-coolant accidents are tabulated. Containment pressure transients caused by loss-of-coolant accidents are analysed. The monitoring procedure for discharge waste is described; systems for detecting containment leakage are discussed. Maximum load requirements of the emergency diesel-generators are tabulated. Electrical cable protection methods are described. (M.L.S.)

32758 (DOCKET-50296-1) BROWNS FERRY NUCLEAR POWER STATION, UNIT 3. Design and Analysis Report. (Tennessee Valley Authority, [Knoxville]). July 13, 1967. 83p. Dep. CFSTI.

Information on Browns Ferry Power Reactor, Unit 3, is given under the following broad headings: Introduction and Summary; Site and Environment; Reactor Design; Reactor Coolant System; Containment Systems; Additional Engineered Safeguards; Radioactive Waste Control Systems; Plant Electrical Systems; Plant Control and Instrumentation; Reactor Auxiliary Services and Systems; Steam and Power Conversion System; Other Plant Structures; Conduct of Operations; Safety Analysis; and Unit Sharing and interactions. A comparative evaluation with AEC design criteria is given. Unit 3 is practically identical to Units 1 and 2; therefore, information is given only in areas where differences occur. Modifications and additions to reactor and power plant systems are tabulated. (M.L.S.)

32759 (DOCKET-50296-2) [BROWNS FERRY NUCLEAR POWER STATION, UNIT 3]. [Design and Analysis Report], Amendment 1. (Tennessee Valley Authority, [Knoxville]). Nov. 21, 1967. 5p. Dep. CFSTI.

The financial qualifications of the Tennessee Valley Authority, owners of Browns Ferry Power Reactor, Unit 3, are given. Estimated construction costs are tabulated. (M.L.S.)

32760 (DOCKET-50309-8) MAINE YANKEE ATOMIC POWER STATION. [Preliminary Safety Analysis Report], Amendment 7. (Maine Yankee Atomic Power Co., Wiscasset). Apr. 30, 1968. 108p. Dep. CFSTI.

The design bases for Class I and Class II structures for the Maine Yankee Power Reactor are given; the structures are categorized. Containment construction procedures are described; applicable codes and standards are delineated. The research and development program for the control element assemblies and drives is discussed. The ability of the fuel to withstand reactor transients at the end of its anticipated lifetime is analysed. The effectiveness of the Emergency Core Cooling System is analysed with respect to size and location of cooling system failure. The heat transfer characteristics and effects of unintentional operation of the cooling spray system are evaluated. The effluent monitoring systems are described; the emergency power system is discussed. (M.L.S.)

32761 (DOCKET-50309-9) MAINE YANKEE ATOMIC POWER STATION. [Preliminary Safety Analysis Report], Amendment 9. (Maine Yankee Atomic Power Co., Wiscasset). May 14, 1968. 82p. Dep. CFSTI.

Blowdown forces and operability of the control element assemblies during blowdown are discussed. Seismic loadings for Operational Basis Earthquake and Design Basis Earthquake are given for reactor vessel internal structures; structural analyses are tabulated for the various components. Effects of isolation valve closure during overpower condition are analysed. Stress loadings for reactor cooling systems and engineered safeguards are calculated; results are tabulated. Safety and performance margins for the engineered safeguards systems are evaluated. (M.L.S.)

32762 (DOCKET-50309-10) MAINE YANKEE ATOMIC POWER STATION. [Preliminary Safety Analysis Report], Amendment 10. (Maine Yankee Atomic Power Co., Wiscasset). May 22, 1968. 133p. Dep. CFSTI.

Maine Yankee Power Reactor compliance with the 70 General Design Criteria is evaluated. Effects of wind loadings on the entire containment structure are analysed; resultant forces, shears, and moments are tabulated. The analytical models used for stress calculations are described. Containment structure lines and penetrations are detailed. Chemical aspects of containment spray and Emergency Core Cooling Systems are detailed. Hypothetical rod withdrawal accidents are analysed. Blowdown effects on core and core support structure are evaluated; an analysis of a potential fuel handling incident is given. Effects on containment of a loss-of-coolant accident are considered; data are shown graphically. Effects of generator tube failure are detailed; whole body and thyroid doses are calculated. A control rod ejection incident is analysed in detail; steam line break accident zero load transients are evaluated. (M.L.S.)

32763 (DOCKET-50317-4) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 1. (Baltimore Gas Electric Co., Md.). Apr. 23, 1968. 294p. (DOCKET-50318-4). Dep. CFSTI.

Revised information on Calvert Cliffs Power Reactor, Units 1 and 2, is given under the following topics: site — including hurricane tidal effects and environmental radioactivity; reactor — including tabulation of all design parameters, fuel design and analyses, and reactor thermal-hydraulics analyses; reactor coolant system; containment system — including design loads and responses; engineered safeguards; instrumentation and controls — including reactor protection and initiation of engineered safeguards systems; auxiliary systems — including chemical and volume control system; and safety analyses — including UO-load initial condition steam line rupture incident, control element assembly ejection incident, loss-of-coolant incident, and steam generator tube rupture incident. (M.L.S.)

32764 (EURFNR-459) BAKO: A CODE FOR COMPUTING COSTS AND STRATEGIES OF BREEDER POWER STATIONS, USING CASH VALUE METHOD. Jansen, P. (Kernforschungzentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). Translated from report KFK-644. 11p. (EUR-3705). Dep. CFSTI.

Work Performed under United States-Euratom Fast Reactor Exchange Program.

The input description of the BAKO code is presented. The code uses data yielded by two-dimensional calculations: zone geometry, composition, and breeding ratio distribution. It calculates, for various thicknesses of the axial and radial blanket and for various service periods of the radial blanket, detailed and specific costs of nuclear electricity and values for the behavior of fast breeder plants in an expanding mixed-plant nuclear economy. (H.D.R.)

32765 (EURAEC-2002) GARIGLIANO STABILITY STUDIES: REPORT ON MY ASSIGNMENT TO GENERAL ELECTRIC, SAN JOSE, FROM 14 MAY TO 27 JULY 1967. Schnurer, H. (Technische Hochschule, Munich (West Germany). Institut fuer Mess- und Regelungstechnik). Aug. 1967. 133p. (EUR-3793). Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

Rod oscillator tests were conducted in the Garigliano nuclear power plant to investigate reactor stability and to examine the accuracy of analytical calculation models. Data processing procedures and results are discussed. Closed-circuit transmission functions were calculated, and an analysis of steady state noise was conducted to estimate noise influence on oscillator results. (H.D.R.)

32766 (IDO-17243) SUBCOOLED PRESSURE GRADIENT CALCULATIONS IN PWR SYSTEMS FOLLOWING PRIMARY COOLANT LOOP BREAKS. Berta, V. T. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Mar. 1968. Contract AT(10-1)-205. 52p. Dep. CFSTI.

Rapid breaks in the primary coolant loop of a PWR system can cause pressure gradients which may initially damage the core, preventing reactor scramming or inhibiting emergency core cooling. An approximation method has been developed to determine the magnitude and duration of the pressure gradients. The method is an empirical formulation involving generalized system and component dimensions and fluid properties and has been compared to results from the LOFT Semiscale Blowdown Test Program. In applying the method to a reactor vessel and connecting piping, the controlling parameters are: cross-sectional areas for coolant flow in the upper plenum, core region, lower plenum, and the inlet and outlet pipes; lengths of the plenums, core, and the coolant pipe from the vessel to the break; the size of the pipe break; and the system pressure and the coolant temperatures and corresponding sound velocities in various regions. The method consists of evaluating a series of equations for each of the two plenums within the vessel. The solutions of the equations in the series for the plenum closest to the pipe break give the pressure relative to the initial system pressure in successive time steps equal to the pipe length from the break to the vessel divided by the coolant sound velocity in the pipe. The solutions of the equations in the series for the other plenum provide the same information in combinations of two time steps, one being the previously defined time step and the other being defined as the core length divided by the coolant sound velocity in the core. Pressure gradients across the core are determined by differencing the pressure in the two plenums immediately above and below the core. The method is considered applicable for a wide value range of the parameters which includes the dimensions for existing and proposed PWR systems. The method is amenable to hand calculation for break areas between 10 and 100 percent of the coolant pipe cross-sectional area. Computer treatment for smaller break areas is preferable as the number of calculations involved becomes large. The method may also be applied to heat exchangers to determine pressure differences across the plenum divider plate. (auth)

32767 (JPRS-45161) CONSTRUCTION OF BULGARIAN ATOMIC POWER STATION AND NUCLEAR ENERGY PROBLEMS. Ruskov, Simeon. Translated from Spis. Bulg. Akad. Nauk, 15-35(July-Oct. 1967). 29p. CFSTI.

Operation of a Bulgarian pressurized-water reactor atomic power station (APS) is compared with the operation of planned thermoelectric power stations (TPS). Optimum economics of performance are discussed. Reactor safety is described and compared to other reactors. (D.C.C.)

32768 (KAPL-M-6734) FITS TO THERMODYNAMIC PROPERTIES OF WATER. Jordan, W. B. (Knolls Atomic Power Lab., Schenectady, N. Y.). Nov. 1, 1967. Contract W-31-109-eng-52. 20p. Dep. CFSTI.

Algebraic fits for enthalpy, temperature and density of water are presented. The fits are designed to cover the range from 1 atm to critical pressure, and from freezing to boiling. Calculations from these fits are compared to data from the Sixth International Conference and the discrepancies are presented in graphical form. (auth)

32769 (KAPL-P-3423) DISCUSSION OF SOME ASPECTS OF INTEGRATED PHYSICS AND THERMAL REACTOR DESIGN. (Knolls Atomic Power Lab., Schenectady, N. Y.). Feb. 20, 1968. Contract W-31-109-eng-52. 8p. Dep. CFSTI.

A discussion of applied integrated physics to thermal reactor design is presented. Design approach for optimum core performance is described. (D.C.C.)

32770 (KFK-657) ANALOGRECHENMODELL FUER DAMPFGEKUEHLTE SCHNELLE REAKTOREN MIT DIREKT-

KREISLAUF. (Analog Computer Model for Steam-Cooled Fast Reactor with Direct Cycle). Frisch, W.; Woite, G. (Kernforschungszentrum, Karlsruhe (West Germany)). Dec. 1967. 59p. (In German). (EUR-3693). Dep.

An analog computer model for the simulation of the dynamics and kinetics of steam cooled fast breeder reactors is given. Included are models for neutron kinetics, heat transfer from fuel element to coolant, coolant pressure differentials across the core, and reactivity feedback effects. 8 references. (M.L.S.)

32771 (KFK-700) DIE ENTWICKLUNG VON BRENNELEMENTEN SCHNELLER BRUTREAKTOREN. (The Development of Fuel Elements for Fast Breeder Reactors). (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). Dec. 1967. 356p. (In German). (EUR-3713). Dep.

Separate abstracts are prepared for each of the papers on fuel element development for the fast breeder reactor. (M.L.S.)

For abstracts of individual papers see: 32772–32778 and 33092–33097.

32772 (KFK-700(Pt. III)) HUELLMATERIALAUSWAHL. (Cladding Material Selection). Laue, H. J. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). 25p. (In German).

Selection criteria for fast breeder reactor fuel element clad materials are considered. The influence of steam and sodium coolants on corrosion rates of austenitic steels and nickel alloys is analysed; the effects of clad materials on neutron transport are discussed. Neutronic and physical characteristics of cladding materials are tabulated. 12 references. (M.L.S.)

32773 (KFK-700(Pt. VII)) BRENNSTOFFZYKLUS UND BRENNELEMENTAUSLEGUNG. (Fuel Cycle and Fuel Element Design). Haefele, W. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). 15p. (In German).

Fuel cycle costs are discussed; techniques for calculating costs are given. The fixed parameters are defined; each is discussed. An optimisation procedure is then formulated. Effects of temperature-induced surface stresses are evaluated. (M.L.S.)

32774 (KFK-700(Pt. VIII)) DIE MECHANISCHE BEANSPRUCHUNG DER BRENNELEMENTHUELLE. (The Mechanical Loading of the Fuel Element Cladding). Laue, H. J. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). 35p. (In German).

A theoretical treatment of the mechanical stresses in metallic materials used for fuel cladding is given. Stress-strain diagrams are given; schematics of plastic deformation of cubic single crystal lattices are shown. The stresses on fuel element cladding caused by internal pressures are treated in detail for sodium and steam cooled reactors. Both austenitic steels and nickel alloys are evaluated as clad materials. 9 references. (M.L.S.)

32775 (KFK-700(Pt. IX)) DIE CHEMISCHE BEANSPRUCHUNG DER BRENNELEMENT-HUELLE. (The Chemical Demands of the Fuel Element Cladding). Leistikow, S. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). 43p. (In German).

Effects of superheated steam on reactor materials are analysed; overall and localized superheated steam-induced corrosion is discussed. Sodium-induced corrosion effects are evaluated. Clad-fuel reactions are considered briefly. 30 references. (M.L.S.)

32776 (KFK-700(Pt. X)) BESTRAHLUNGSVERSUCHE AN HUELLMATERIALIEN UND IHRE AUSWERTUNG. (Radiation Tests on Cladding Materials and Their Interpretation). van den Boorn, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). 28p. (In German).

An overall evaluation of the radiation testing program for fast breeder reactor fuel element cladding materials is given. The experiments in the BR-2 are described; irradiation conditions for steels, iron alloys, nickel alloys, and vanadium alloys are given. The DIDO experiments are described. (M.L.S.)

32777 (KFK-700(Pt. XI)) DIE AUSLEGUNG UND DURCHFUEHRUNG VON BRENNELEMENT-BESTRAHLUNGSEXPERIMENTEN. (The Design and Execution of Fuel Element Irradiation Experiments). Beisswenger, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). 28p. (In German).

The planning of fuel element irradiation experiments is described. Criteria for radiation testing in both fast and thermal reactors are outlined. The irradiation facilities used for the tests are described in detail. Results of tests in the EFFBR, DFR, and FR-2 are given; all data are shown graphically. (M.L.S.)

32778 (KFK-700(Pt. XII)) DIE NACHUNTERSUCHUNG BEI BRENNELEMENT-BESTRAHLUNGSEXPERIMENTEN. (Examination of Irradiated Experimental Fuel Elements). Geithoff, D. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). 29p. (In German).

The test samples used as fuel probes for the development of fast breeder reactor fuels are described. Photographic inspection techniques, density determinations, dimensional determinations, neutron radiographic techniques, gamma-scanning, and autoradiographic techniques, which were used, are described. Examination of punctured and disassembled samples is discussed. (M.L.S.)

32779 (NAA-SR-Memo-11658) FUEL ELEMENT ORIFICE OPERATION REVIEW. Beyer, F. R. (Atomics International, Canoga Park, Calif.). Oct. 22, 1965. 47p. DTIE.

A review of the design and testing histories of the Mark I and Mark II orifices is presented. Mechanical properties of the orifices are described. Torquing capacities of the mechanisms and design alterations to prevent orifice sticking are presented. Design drawings are included. (D.C.C.)

32780 (ORNL-NSIC-44) INDEXED BIBLIOGRAPHY OF CURRENT NUCLEAR SAFETY LITERATURE-13. (Oak Ridge National Lab., Tenn.). May 1968. Contract W-7405-eng-26. 436p. Dep. CFSTI.

An annotated bibliography on nuclear safety literature and information is given. The information is categorized according to the following: general safety criteria; siting of nuclear facilities; transportation and handling of radioactive materials; aerospace safety; accident analysis; reactor transients, kinetics, and stability; fission product release, transport, and removal; sources of energy release under accident conditions; nuclear instrumentation, control, and safety systems; electrical power systems; containment of nuclear facilities; plant safety features; radiochemical plant safety; radionuclide release and movement in the environment; environmental surveys, monitoring and radiation exposure of man; meteorological considerations; operational safety and experience; and safety analysis and design reports. Author and subject indexes are included. (M.L.S.)

32781 (ORNL-TM-61) EVALUATION OF THE EGCR CATALYTIC OXIDIZER FOR OXIDATION OF HYDROGEN, CARBON MONOXIDE, AND METHANE. Scott, C. D. (Oak Ridge National Lab., Tenn.). Nov. 28, 1961. Contract W-7405-eng-26. 25p. Dep. CFSTI.

The oxidizing catalyst for the EGCR helium purification system is to be a Ni–Cr–Pd ribbon catalyst. This catalyst has been evaluated for a range of operating parameters for the oxidation by oxygen of hydrogen, carbon monoxide, and methane in a flowing system of helium at 300 psia. Empirical correlations suitable for design purposes were determined for the effects of temperature in the range of 400 to 600°C; total gas mass flow rate in the range of 0.083 to 1.00 g-moles/cm^2-min; and contaminant levels in the range of $\sim$0.5 to 2.0 vol %. The existing oxidizer is adequate for oxidation of anticipated maximum hydrogen and carbon monoxide contamination if the allowable effluent oxygen concentration is greater than 10 ppM. If methane oxidation capacity is desired, the allowable effluent oxygen concentration must be above 100 ppM or the catalytic oxidizer must be made larger. (auth)

32782 (ORNL-TM-910) MSRE DESIGN AND OPERATIONS REPORT. PART X. MAINTENANCE EQUIPMENT AND PROCEDURES. Blumberg, R.; Hise, E. C. (Oak Ridge National Lab., Tenn.). June 1968. Contract W-7405-eng-26. 86p. Dep. CFSTI.

The methods of maintaining the radioactive portions of the Molten Salt Reactor Experiment (MSRE) is presented. The maintenance system utilizes long-handled tools operated through a movable shield for most of the in-cell manipulations. For some radioactive transfer and setup tasks that cannot be handled otherwise, a crane that is operated remotely from a shielded control room is used. Overall descriptions are given of the components and the methods of maintenance, the procedures written from the standpoint of the people who perform the work are presented. Reference material that will be useful when detailed information is required is included. (auth)

32783 (ORNL-TM-1937) SODIUM BURNING AND AEROSOL RELEASE: AN EVALUATION OF THE STATE OF THE ART. MacPherson, R. E. (Oak Ridge National Lab., Tenn.). May 6, 1968. Contract W-7405-eng-26. 33p. Dep. CFSTI.

In a sodium-cooled reactor, the possibility of sodium fires and the resultant release of aerosols strongly influence containment vessel design and operating safety criteria. Qualitative investigations of sodium pool fires and spray fires have been carried out in conjunction with each major sodium-cooled reactor project.

Recently, more quantitative studies were undertaken in these areas, and the problem of explosive injection of sodium sprays into containment volumes was investigated. Work is also underway to characterize aerosols released from sodium fires and to define their performance in the containment volume. The work on sodium fires and aerosol release, a review of the scope of current programs, and proposed additional efforts to provide safety criteria for liquid-metal-cooled fast-reactor design are described. (auth)

32784 (RISO-M-725) BIBLIOGRAPHY ON THE APPLICATION OF DIGITAL COMPUTERS IN POWER STATIONS, 1962–1967. Hansen, Kjeld (Danish Atomic Energy Commission, Risoe. Research Establishment). Mar. 1968. 19p. (R-12-68). Dep.

Presented is a survey of some articles concerning the application of digital computers controlling power stations. The articles have been selected from the period of 1962–1967 and give examples from power stations in Europe, USA, and Canada. Included are some tabular surveys of computer installations in operating power stations. (auth)

32785 (TID–24226) EMERGENCY CORE COOLING. Report of Advisory Task Force on Power Reactor Emergency Cooling. (Atomic Energy Commission, Washington, D. C.). [1967]. 229p. Director of Regulation, AECW Free.

Results of the study of the Advisory Task Force on Power Reactor Emergency Cooling are presented. Conclusions and discussions are given on the following topics: Phenomena Associated with Loss-of-Coolant; Structural Response Requirements to Blowdown; Requirements of Emergency Core-Cooling System; Technology of Emergency Core-Cooling; Practicability of Emergency Core-Cooling Systems; Reliability Analysis; Primary System Integrity; Break Size for Emergency Core-Cooling Design; Safeguards Role of Containment; Core Meltdown; Countermeasures Prior to Loss of Containment Integrity; and Handling of Large Molten Masses. Appendices include: Description of Calculational Methods and Digital Computer Codes for Analysing Coolant Blowdown and Core Heatup Phenomena; Experimental Verification of Performance of Emergency Core-Cooling Systems; Primary System Integrity Experience in Water-Cooled Nuclear Power Plants; Some Publications Pertinent to Primary System Integrity; Core History Without Effective Emergency Core Cooling; Fission Product Behavior During an Accident Without Effective Emergency Core Cooling; Steam Explosions; and Some Considerations of Molten Masses. (M.L.S.)

32786 (TID–24305) GARIGLIANO NUCLEAR POWER PLANT ANNUAL REPORT, 1965. (Ente Nazionale per l'Energia Elettrica, Rome (Italy)). 1967. 84p. Dep. CFSTI.

The period of activity from 1 April 1965 to 30 April 1966 is described. During the period in question, the Garigliano Power Plant operated normally up to 24 September 1965, when it was shut down for scheduled maintenance and channel replacement. The plant was started up again on 1 May 1966. The operating data for the period from 1 April to 24 September 1965 and full information on the work carried out throughout the shut-down period are included. (auth)

32787 (TID–24306) GARIGLIANO NUCLEAR POWER PLANT ANNUAL REPORT 1966. (Ente Nazionale per l'Elettrica, Rome (Italy)). 1967. 102p. Dep. CFSTI.

Described is the Garigliano Station operating period from May 1, 1966, to February 28, 1967. In said period the plant operated with an availability factor of about 89% and generated a total of approximately 1000 million kWhrs. The average fuel burnup since the plant was placed on line reached 7730 MWd/t of uranium, corresponding to a consumption of about 235 kg of ^{235}U and a production of about 184 kg of plutonium. A number of tests were performed in May to assess the stability of the reactor under higher power density and void content conditions. These tests demonstrated the good stability of the reactor in very severe operating conditions. With regard to core performance, various control rod patterns and withdrawal sequences were considered in order to determine those giving highest uniformity in fuel consumption. In these studies, the computer proved to be an essential tool. It allowed a considerable amount of data to be collected and processed very quickly, thus providing extremely useful information on power distribution and, in general, on the thermohydraulic parameters which characterize core performance. The core pressure drop gradually increased, but was always well within the operation safety limits. In this reporting period, the Δp rose from 1.61 to 5.66 psi at a daily rate of 0.016 psi. The suspended material in the primary circuit water—with iron prevailing over copper and nickel—remained at relatively low values. Instead, an increased copper content, contributed more or less in the same measure by the high-temperature and low-temperature heaters, was found in the dissolved corrosion products. The amount of corrosion products in solution was also rather low. The plant radiation levels in the reporting period did not differ substantially. As to personnel health physics, the use of whole body counters allowed immediate checks and a constant control of the efficiency of the equipment and procedures adopted at the site. (auth)

32788 (UNC–5213) PERFORMANCE EVALUATION OF HEAT EXCHANGERS FOR SODIUM-COOLED REACTORS. Quarterly Technical Progress Report, January 1–March 31, 1968. Israel, S. L.; Nolan, D. J.; Malmborg, F. B. (United Nuclear Corp., Elmsford, N. Y. Research and Engineering Center). Apr. 20, 1968. Contract AT(11-1)-1452. 33p. Dep. CFSTI.

The thermal-hydraulic and structural performance of heat exchangers for Na-cooled reactor plants are being evaluated. The evaluation will be based on the results of tests of model heat exchangers [approximately 30 MW(t)] in the Sodium Components Test Installation (SCTI). An intermediate heat exchanger designed and manufactured by ALCO Products, Inc. (ALCO), and a steam generator designed by ALCO and manufactured by Baldwin-Lima-Hamilton Corporation (BLH) are the first units to be tested. A Babcock & Wilcox (B&W) steam generator is to be tested next. A review of the entire instrumentation system was continued to assure that all necessary information was available for proper reduction and interpretation of experimental data. The review concentrated on Na pressure and Na flow measurements and thermocouple calibrations. Rise-to-power test data were used to ascertain whether or not the unusual heat transfer characteristics in the superheat region of the steam generator, which had been reported earlier, were due to instrument uncertainties. It is concluded that the unexpected behavior is real. Liquid entrainment is a possible cause, but final conclusions must await data from the specified performance tests. A brief study was undertaken to determine whether any undesirable effect would be encountered if the steam pressure relief valve was mounted in the manway cover of the steam generator. Tentative procedures have been outlined for the structural evaluation of the heat exchangers, based on their operating history. The procedure identifies structurally significant events which occur at any time while the units are installed in the SCTI. Depending on the extent of the event, the data will be recorded or analyzed in varying degrees of depth. (auth)

32789 (WAPD-MRP-124) PRESSURIZED WATER REACTOR (PWR) PROJECT. Technical Progress Report, January 27–April 26, 1968. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Contract AT(11-1)-Gen-14. 40p. Dep. CFSTI.

SHIPPINGPORT PRESSURIZED-WATER REACTOR—operation during January to April 1968, description of
HEAT TRANSFER SYSTEMS—performance of Shippingport Pressurized-Water Reactor, during January to April 1968
ALUMINUM—corrosion by potassium tetraborate in water
POTASSIUM TETRABORATES—corrosive effects on aluminum, measurement of
REACTOR FUEL ELEMENTS—cycle for Shippingport Pressurized-Water Reactor, description of; shipping of irradiated Shippingport Pressurized-Water Reactor, thermal testing of containers for; radiation effects on mechanical properties of $CaO-UO_2-ZrO_2$, analysis of neutron
REACTOR LOADING MACHINES—performance of Shippingport Pressurized-Water Reactor, description of improvements in
HANDLING AND STORAGE—fuel element shipping container, thermal testing of Shippingport Pressurized-Water Reactor
XENON ISOTOPES—measurement of Shippingport Pressurized-Water Reactor shutdown, analysis of transient test
REACTIVITY—effects of xenon transients on Shippingport Pressurized-Water Reactor shutdown, analysis of
NEUTRONS—effects on mechanical properties of $CaO-UO_2-ZrO_2$ fuel elements, analysis of
URANIUM OXIDES UO_2—$CaO-UO_2-ZrO_2$, radiation effects on mechanical properties of, analysis of neutron
CALCIUM OXIDES—$CaO-UO_2-ZrO_2$, radiation effects on mechanical properties of, analysis of neutron
ZIRCONIUM OXIDES—$CaO-UO_2-ZrO_2$, radiation effects on mechanical properties of, analysis of neutron (D.C.C.)

32790 RECENT STUDIES OF THE DOPPLER EFFECT IN HETEROGENEOUS SYSTEMS. Miller, L. B.; Hwang, R. N. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 206(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32791 EFFECTS OF HIGH CAPTURE-TO-FISSION RATIO OF ^{239}Pu ON THE PERFORMANCE OF FAST BREEDER REACTORS. Butler, D. K.; Bogner, M.; Loewenstein, W. B.

(Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 204-5(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32792 RADIATION AND THERMAL STABILITY OF SPRAYS. Zittel, H. E.; Row, T. H. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 375-6(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32793 FLOATING EARTHQUAKE-RESISTANT LARGE NUCLEAR POWER STATIONS. Busey, Harold M. (McDonnell Douglas Corp., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 370(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32794 HAZARDS EVALUATION OF PRIMARY-TO-SECONDARY SYSTEM COOLANT LEAKAGE IN A PRESSURIZED WATER REACTOR. Smith, E. R.; Daniels, R. S. (Nuclear Utility Services, Washington, D. C.). Trans. Amer. Nucl. Soc., 11: 371(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32795 LARGE-SCALE SPRAY TESTS IN THE CONTAINMENT SYSTEMS EXPERIMENT (CSE). McCormack, J. D.; Hilliard, R. K.; Coleman, L. F. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc., 11: 371-2(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32796 STUDIES OF THE REMOVAL OF IODINE VAPOR FROM CONTAINMENT BUILDING ATMOSPHERES AT THE NUCLEAR SAFETY PILOT PLANT. Parsly, L. F. Jr.; Franzreb, J. K. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 372-3(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32797 DISTRIBUTION OF IODINE BETWEEN AIR AND AQUEOUS SOLUTIONS. Patterson, C. Stuart; Humphries, William T. (Furman Univ., Greenville, S. C.). Trans. Amer. Nucl. Soc., 11: 374(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32798 UPTAKE OF METHYL IODIDE FROM WIND TUNNEL GASES BY A SUSPENDED DROP OF WATER. PART II. Soldano, B. A.; Ward, W. T. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 374-5(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32799 ANALYTICAL-EXPERIMENTAL COMPARISON OF THE INITIAL TRANSIENT RESPONSE OF HIGH ENTHALPY WATER DURING DECOMPRESSION. Goulding, H. (Dilworth, Secord, Meagher and Associates, Ltd., Toronto). Trans. Amer. Nucl. Soc., 11: 365-6(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32800 A SYNTHESIS METHOD FOR CALCULATING TEMPERATURE, POWER, AND BOWING REACTIVITY COEFFICIENTS OF FAST POWER REACTORS. Blomberg, Pehr E. (Argonne National Lab., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc., 11: 208-9(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32801 RADIATSIONNAYA BEZOPASNOST' NA YADERNYKH REAKTORAKH. (Nuclear Reactor Radiation Safety). Sivintsev, Yurii Vasil'evich. Moscow, Atomizdat, 1967. 638p.

Presented is a summary of Soviet and non-Soviet experience in radiation protection methods and safe operation of various nuclear reactors. The book stresses dosimetry rather than conventional shielding and radiation protection methods. The appendix provides ready reference to various types of reactors and some physical constants. (ATD)

32802 TEPLONOSITELI ENERGETICHESKIKH YADERNYKH USTANOVOK. (Coolants for Nuclear Power Plants). Ulybin, Sergei Arkhipovich. Moscow, Izdatel'stvo Energiya, 1966. 271p.

The special features of coolants used in nuclear power reactors are presented. The effect of nuclear radiation on the properties of coolants and the corrosion of construction materials is described, and approximate methods for calculating coolant radioactivity are given. A detailed description is given of the thermophysical, corrosive, and other properties of water-, organic-, liquid-, metal-, and gas-coolants used in nuclear power engineering. The characteristics of design and use of reactors which are influenced by the type of coolant are discussed. The book is intended for students of institutes specializing in the design and use of nuclear power stations. It can be also useful for engineering-technical personnel working in industry and design organizations connected with nuclear engineering. (ATD)

32803 TEMPERATURE AND STRESS FACTORS IN A PEBBLE BED REACTOR. Holy, Z. J. (Univ. of New South Wales). Mech. Chem. Eng. Trans., 2: 43-9(Nov. 1966).

The temperature and thermoelastic factors due to non-uniform heat transfer over the surface of a spherical fuel element for a pebble bed reactor are discussed. Solutions for the temperature and thermoelastic stresses are developed for axisymmetric heat transfer coefficient variation in terms of a truncated series of mutually orthogonal eigenfunctions. A number of results are presented and conclusions drawn as to their applicability to a nonsymmetric heat transfer distribution. (auth)

32804 CONSTRUCTION OF REACTOR COMPONENTS. Wassenaar, K.; Van Veen, M. C.; Van Elst, H. C.; Van der Laken, R. A.; Drucker, E. E.; Leutscher, H.; De Haas van Dorsser, A. H. R.C.N. Meded. No. 25. The Hague, Reactor Centrum Nederland, 1968. 96p. (In Dutch).

Seven papers discuss the construction of the first Dutch reactor for electric power production (1), pressure vessels and construction for core support in H_2O-moderated reactors (2), methods for determining the brittleness of neutron-irradiated steel (3), legislative prescriptions (4), pressurizer dynamics, (5), and components for water-cooled (6) and Na-cooled reactors (7). (J.J.t.B.)

32805 ON THE STEEL AND ALLOY TUBES AND PIPE FOR NUCLEAR POWER GENERATION. Ogura, Seiitsu; Suzuki, Jun (Sumitomo Metal Ind., Ltd., Japan). Sumitomo Kinzoku, 19: 108-26(Oct. 1967). (In Japanese).

Varieties of pipes and tubes, which are different in many aspects from those used in the conventional chemical plants or thermal power plants, are employed in nuclear power plants of the light-water type. These pipes and tubes, manufactured mainly as prototype ones, are described in sections on: the kinds of pipe and tube and their characteristics for nuclear power generation; production and properties of nuclear-power generation pipes and tubes [fuel cladding tubes, including Zr-2 tubes, large-diameter welded stainless-steel pipes, large-diameter jointless stainless-steel pipes, and HN75 (75Ni-15Cr) alloy pipes]; and testing of the manufactured pipes and tubes. (NSA of Japan)

32806 PARAMETER STUDIES CONCERNING THE FLOW BEHAVIOUR OF A PEBBLE WITH REFERENCE TO THE FUEL ELEMENT MOVEMENT IN THE CORE OF THE THTR 300 MWe PROTOTYPE REACTOR. Bedenig, D.; Rausch, W.; Schmidt, G. (Brown Boveri/Krupp Reaktorbau GmbH, Juelich, Ger.). Nucl. Eng. Design, 7: 367-78(1968).

The knowledge of the pebble bed flow behavior is of great importance for gas-cooled high temperature reactors of the pebble bed type. Comprehensive experimental investigations were carried out in this respect. After a short description of the methods of measurement the results of parameter studies with reference to the flow behavior of a pebble bed are discussed. Various parameters of geometry are investigated as well as the influence of friction, specific ball weight and relative ball diameter as functions of pebble bed height. Results are plotted in form of residence spectra. From these results the flow behavior of the THTR 300 MWe prototype reactor is predicted by interpolation. 8 references. (auth)

32807 THERMAL PERFORMANCE OF CERAMIC-CLAD GAS-COOLED REACTOR CORES. Melese-D'Hospital, G. (Gulf General Atomic Inc., San Diego, Calif.). Nucl. Eng. Design, 7: 322-33(1968).

Simple relations between dimensionless core parameters have been derived for the case where the maximum internal fuel temperature is fixed. The linear rating is found to be nearly proportional to the difference between maximum fuel and coolant temperatures and to the effective fuel conductivity. The ratio of core pressure drop to average coolant pressure is determined. Numerical results for a typical High Temperature Gas Cooled Reactor design show the lack of sensitivity of thermal power to channel dimensions and the rapid variations of pumping power with channel geometry. (auth)

32808 330-MW(e) FORT ST. VRAIN HIGH-TEMPERATURE GAS-COOLED REACTOR. Habush, A. L.; Harris, A. M. (Gulf General Atomic Inc., San Diego, Calif.). Nucl. Eng. Design, 7: 312-21(1968).

A description of the principal design features of the 330 MW(e)

Fort Saint Vrain high-temperature gas-cooled reactor system is given. The reactor will utilize the same fundamental principles as are incorporated in the 40 MW(e) prototype HTGR located at Peach Bottom, Pa. These principles include the use of helium gas as the coolant, graphite as the fuel-element structural material, moderator, and reflector, and a uranium-thorium fuel cycle. The primary coolant system will incorporate, however, a number of significant new design features, the most prominent of which are the use of a prestressed concrete reactor vessel (PCRV), once-through modular steam generators, steam-driven axial-flow helium circulators, and hexagonal-shaped graphite fuel elements incorporating improved carbon-coated particles. (auth)

32809 ENGINEERING TESTS DURING THE INITIAL OPERATION OF THE PEACH BOTTOM HTGR. Kantor, M. E.; Menzel, H. F.; Schlicht, R. W. (Gulf General Atomic Inc., San Diego, Calif.). Contract AT(04-3)-314. Nucl. Eng. Design, 7: 297-311 (1968).

The initial power operation of the Peach Bottom Atomic Power Station was programmed as a series of physics, engineering and chemistry tests. These were performed in the first half of 1967 and were successful in bringing the reactor to full power in carefully measured stages which assured both safety and complete verification of earlier design predictions. The steam generators required modifications during these tests but successfully produced design capacity at the design steam conditions of 1000°F at 1450 psig. The plant controls met design requirements of controlling these values closely at steady state and at load change rates of up to three percent per minute, with the reactor and steam generators following turbine load demand. Plant safety actions (scram, setback, loop isolation) were also tested and proved to be much gentler than originally predicted. The overall plant produced a maximum of 44.5 MW(e) gross with a maximum measured efficiency of 38.7% gross, believed to be the highest nuclear power plant performance yet achieved. Main coolant gaseous activity has remained well below 1 Curie total and all the chemical impurities are well below design limits. Power production continued through 1967 with periodic testing and maintenance operations requiring occasional shutdowns. (auth)

32810 HIGH-TEMPERATURE GAS-COOLED REACTOR FUEL AND FUEL CYCLES: THEIR PROGRESS AND PROMISE. Jaye, S.; Goeddel, W. V. (Gulf General Atomic Inc., San Diego, Calif.). Contracts AT(04-3)-167; AT(04-3)-633. Nucl. Eng. Design, 7: 283-96(1968).

A discussion of fuel and fuel cycles for the High-Temperature Gas-Cooled Reactor (HTGR) is given. A survey of design features, analytical models, and irradiation testing results of pyrolytic carbon coated fuel particles is presented. Several potentially attractive fuel cycle possibilities are discussed; trends in fuel and fuel cycle costs for large HTGRs are analyzed. 22 references. (auth)

32811 ASYMMETRIC SOURCE METHOD OF MEASURING REACTOR SHUTDOWN. Walter, J. F.; Henry, A. F. (Bettis Atomic Power Lab., West Mifflin, Pa.). Nucl. Sci. Eng., 32: 332-41(1968).

An artificial neutron source located within a subcritical reactor at a position that is asymmetric with respect to a line or a plane of symmetry will give rise to a neutron flux shape that is itself asymmetric. The ratio of counting rates from two counters at different locations will then depend on the degree of subcriticality of the reactor, and this ratio can be used to infer the effective multiplication constant of the system provided certain auxiliary parameters, which must be either computed or obtained by experimental calibration, are known. This situation is analyzed theoretically and some simple numerical experiments are presented which suggest that the auxiliary parameters may be taken as constants in some cases. 17 references. (auth)

32812 HAFNIUM CONTROL ROD BEHAVIOR IN THE SHIPPINGPORT PRESSURIZED WATER REACTOR. Salvaggio, G. J. (Westinghouse Electric Corp., Pittsburgh). Nucl. Appl., 5: 26-34(July 1968).

Hafnium control rods removed at three intervals during the operation of the first core of the Shippingport PWR reactor were destructively tested for Hf isotope concentrations, corrosion, tensile properties, and fatigue behavior. The material examined had received a fluence ranging from 1 to 14×10^{20} n/cm^2 thermal ($E < 0.625$ eV) and 0.9 to 6×10^{21} n/cm^2 fast (>1 MeV). Chemical analysis shows only minor irradiation-induced changes in the relative amounts of Hf isotopes. The surface buildup of transmutation products Ta and Lu, which may alter the out-of-reactor corrosion of Hf, apparently has no effect on in-service corrosion. Irradiation to a fluence of 6×10^{21} n/cm^2 (>1 MeV) produced a marked increase in strength and a modest decrease in ductility with increasing fluence, e.g., the yield strength at room temperature increased from 27,000 to 97,000 psi while the total elongation decreased from 35 to 12% and the reduction in area decreased from 35 to 20%. Similar relative changes occurred at 300 and 600°F test temperature. Strain-controlled fatigue tests at 600°F indicate only slight improvement in fatigue life at low strains after irradiation but shorter life than nonirradiated material at high-strain levels. The results of all the post-irradiation tests performed clearly indicate the adequacy of hafnium as a long-life neutron absorber material in pressurized water reactors. (auth)

32813 RESULTS AND CONCLUSIONS FROM THE EXAMINATION OF FUEL SUBASSEMBLIES REMOVED FROM THE ENRICO FERMI REACTOR AFTER THE FUEL DAMAGE INCIDENT. Rateick, Richard C. (Power Reactor Development Co., Monroe, Mich.); McHugh, William E.; Saling, James H. Trans. Amer. Nucl. Soc., 11: 100-1(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32814 INTERNAL GAS PRESSURE MEASUREMENTS IN PRTR MIXED-OXIDE FUEL RODS. Burley, T. B.; Freshley, M. D. (Battelle Memorial Inst., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 106-7(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32815 DEVELOPMENT OF MIXED-NITRIDE FUEL MATERIALS OBTAINED BY CARBOTHERMIC REDUCTION OF OXIDES. Weber, E. T.; Greenhalgh, W. O.; Gibby, R. L. (Battelle Memorial Inst., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 104(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32816 NITRIDE FUEL: CLADDING COMPATIBILITY. Hebeisen, J. C.; Price, D. E.; Moak, D. P. (Battelle Memorial Inst., Columbus, Ohio). Trans. Amer. Nucl. Soc., 11: 104-5 (June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32817 OBSERVATIONS ON METALLIC INGOTS FORMED DURING IRRADIATION OF MIXED-OXIDE FUEL. O'Boyle, D. R.; Brown, F. L. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 101-2(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32818 IRRADIATION PERFORMANCE OF (U,Pu)N FAST REACTOR FUELS. Basmajian, J. A.; Horn, Glen R. (Battelle Memorial Inst., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 102(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32819 OPERATING PERFORMANCE OF AVR FUEL SPHERES. Ehlers, K. D. (Brown Boveri/Krupp Reaktorbau GmbH, Mannheim, Ger.); Smith, E. R.; Scarborough, J. C. Trans. Amer. Nucl. Soc., 11: 108-9(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32820 POSTIRRADIATION EXAMINATION OF THE PM-1 TYPE-1 SERIAL-3 CORE AND CORRELATION WITH PM-3A CORE EXAMINATION. Brown, John B. Jr.; Storhok, V. W. (Battelle Memorial Inst., Columbus, Ohio). Trans. Amer. Nucl. Soc., 11: 109-10(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32821 POSTIRRADIATION EXAMINATION OF SPECIAL ASSEMBLY SA-1. Megerth, F. H. (General Electric Co., San Jose, Calif.). Trans. Amer. Nucl. Soc., 11: 110-11(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32822 NUMERICAL SOLUTION OF THE COUPLED CORE EQUATIONS. Koen, B. V.; Hansen, K. F. (Massachusetts Inst. of Tech., Cambridge). Trans. Amer. Nucl. Soc., 11: 167-8 (June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32823 NODAL SPACE-TIME KINETICS MODELS INTERPRETED IN TERMS OF MODAL EXPANSIONS. Wade, David C. (Knolls Atomic Power Lab., Schenectady, N. Y.). Trans. Amer. Nucl. Soc., 11: 168-9(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32824 MODAL ANALYSIS OF POWER TILTING. Rohr, P. C.; Becker, M. (Rensselaer Polytechnic Inst., Troy, N. Y.). Trans. Amer. Nucl. Soc., 11: 169(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32825 NUMERICAL STUDY OF SINGLE-CHANNEL FLUX SYNTHESIS. Adams, Cyrus H.; Rydin, Roger A.; Stacey, Weston M. Jr. (Knolls Atomic Power Lab., Schenectady, N. Y.). Trans. Amer. Nucl. Soc., 11: 169-70(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32826 SPACE-ENERGY SYNTHESIS TECHNIQUES FOR FAST REACTOR CALCULATIONS. Murley, T. E.; Williamson, J. W. (Westinghouse Electric Corp., Madison, Pa.). Trans. Amer. Nucl. Soc., 11: 174-5(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32827 ELECTRON MICROSCOPY OF IRRADIATED EBR-II FUEL CLADDING. Stiegler, J. O.; Bloom, E. E.; Weir, J. R. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 146(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32828 COMPATIBILITY OF FLUOROBORATE COOLANT SALTS WITH HASTELLOY N FOR MOLTEN SALT REACTORS. Litman, A. P.; Koger, J. W. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 143(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32829 VARIATIONAL MULTICHANNEL SPACE-TIME SYNTHESIS MODEL FOR THE ANALYSIS OF NONSEPARABLE TRANSIENTS. Stacey, Weston M. Jr. (Knolls Atomic Power Lab., Schenectady, N. Y.). Trans. Amer. Nucl. Soc., 11: 170-1 (June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32830 COMBINED SPACE-TIME SYNTHESIS MODEL: NUMERICAL COMPARISONS WITH EXACT TWO-GROUP TWO-DIMENSIONAL TRANSIENT SOLUTIONS. Yasinsky, J. B.; Lynn, L. L.; Kaplan, S.; Porsching, T. A. (Bettis Atomic Power Lab., West Mifflin, Pa.). Trans. Amer. Nucl. Soc., 11: 172-3(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32831 SUPPLY OF URANIUM TO MEET THE REQUIREMENTS OF THE NUCLEAR AGE. Gilchrist, William K. (Eldorado Mining and Refining Ltd., Port Hope, Ont.). Trans. Amer. Nucl. Soc., 11: 124(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32832 URANIUM DEMAND: CRITERIA FOR FORECASTING. Sherman, John T. (Atomic Industrial Forum, New York). Trans. Amer. Nucl. Soc., 11: 124(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32833 SELECTION OF MATERIALS FOR STEAM GENERATORS FOR NUCLEAR REACTORS. Manly, W. D. (Union Carbide Corp., New York). Trans. Amer. Nucl. Soc., 11: 125(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32834 MATERIALS BEHAVIOR ON THE SODIUM-WETTED SIDE IN STEAM GENERATORS AND THEIR CIRCUITS. Pearlman, Harry (Atomics International, Canoga Park, Calif.). Trans. Amer. Nucl. Soc., 11: 126-8(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32835 CORROSION OF MATERIALS SUITABLE FOR STEAM GENERATORS IN PRESSURIZED WATER REACTORS. Bryant, P. E. C. (Chalk River Nuclear Labs., Ont.). Trans. Amer. Nucl. Soc., 11: 125-6(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32836 DESIGN AND FABRICATION OF STEAM GENERATORS FOR NUCLEAR SERVICE. Stone, W. A. (Combustion Engineering, Inc., Chattanooga). Trans. Amer. Nucl. Soc. 11: 125(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32837 APPLICATION OF RELIABILITY MARGIN ANALYSIS TO FAST BREEDER REACTOR FUEL-PIN DESIGN. Sayles, C. W.; Sletten, H. L.; Mahlmeister, J. E.; Burgess, D. S. (Atomics International, Canoga Park, Calif.). Trans. Amer. Nucl. Soc., 11: 133-4(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32838 DERIVATION OF A SINTERING CORRECTION FACTOR FOR FAST OXIDE FUELS. Stevens, E. G. (Battelle Memorial Inst., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 130-1 (June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32839 OPERATING EXPERIENCES OF STEAM GENERATORS IN PRESSURIZED-WATER NUCLEAR PLANTS. Byerley, W. M. (Westinghouse Electric Corp., Philadelphia). Trans. Amer. Nucl. Soc., 11: 136(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32840 PEACH BOTTOM STRESS CORROSION CRACKING. Hull, L. J.; Watson, J. F. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc., 11: 136-7(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32841 ENRICO FERMI STEAM GENERATOR EXPERIENCE. Sliper, E. G. (Detroit Edison Co.). Trans. Amer. Nucl. Soc., 11: 137(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32842 OPERATING EXPERIENCE OF STEAM GENERATORS IN ORGANIC-COOLED NUCLEAR REACTORS. Jacobson, J. (Atomics International, Canoga Park, Calif.). Trans. Amer. Nucl. Soc., 11: 137-8(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32843 THERMAL PERFORMANCE OF THE FERMI INTERMEDIATE HEAT EXCHANGERS (IHX'S). Markley, Robert A. (Westinghouse Electric Corp., Madison, Pa.); Kirkby, Robert C. Trans. Amer. Nucl. Soc., 11: 278-9(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32844 RECENT EBR-II EXPERIENCE. Rice, R. E.; Cerutti, B. C.; Cissel, D. W.; Deegan, G. E.; Kirn, F. S. (Argonne National Lab., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc., 11: 279(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32845 EXPERIENCE WITH A GAS-TYPE FAILURE IN AN EBR-II DRIVER FUEL ELEMENT. Smith, R. R.; Ebersole, E. R.; Thalgott, F. W. (Argonne National Lab., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc., 11: 279-80(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32846 EFFECT OF REDUCED FLOW CONDITIONS ON THE POWER COEFFICIENT OF EBR-II. Long, J. K.; Kirn, F. S. (Argonne National Lab., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc., 11: 280-1(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32847 EBR-II POWER COEFFICIENT VARIATIONS DURING OPERATIONAL RUN 26. Persiani, P. J. (Argonne National Lab., Ill.); Kallfelz, J.; Kirn, F.; Long, J. K.; Smith, R. Trans. Amer. Nucl. Soc., 11: 281-2(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32848 ANALYSIS OF THE VARIATION IN THE EBR-II POWER COEFFICIENT DUE TO BLANKET CHANGE. Persiani, P. J. (Argonne National Lab., Ill.); Bump, T. R.; Cushman, R. A.; Long, J.; Kucera, D. Trans. Amer. Nucl. Soc., 11: 282 (June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32849 PROBLEMS FOR THE FUEL CYCLES OF NUCLEAR REACTORS IN JAPAN. Imai, Takayoshi; Nukazuka, Hideo (Japan Atomic Power Co., Tokyo). Genshiryoku Kogyo, 13: No. 10, 41-4; 51(Oct. 1967). (In Japanese).

Problems in the fuel cycles in Japan power reactors are described, with some emphasis on the Tsuruga BWR plant. Discussion includes: acquirement of uranium concentrates (enrichment determination, U. S. AEC's waste "enrichment," reserve fuel), conversion to UF_6, commissioning of the fuel enrichment, damage of the fuels, and disposal of spent fuels. (NSA of Japan)

32850 ON THE PRESSURIZED LIGHT-WATER COOLED REACTOR, WITH THE MIHAMA ATOMIC POWER STATION AS AN EXAMPLE. Kuwashima, Kenshin (Kansai Electric Power Co., Inc., Japan). Sutenresu, 11: No. 12, 51-7(Dec. 1967). (In Japanese).

The Mihama atomic power station of Kansai Power Company is outlined. The stainless steels used in such reactor plants are briefly described. The light-water reactors, the BWR and the PWR are compared in the characteristic features, including the containment, reactor control, etc.; the economy of the nuclear power plants is also described. The Mihama atomic power station, which employs a PWR type reactor of Westinghouse with electric output 340 MW is outlined in the reactor and its core, the primary coolant system, and plant auxiliary facilities. The uses of stainless steels are described. (NSA of Japan)

32851 ON THE FIELD PIPING-WORK FOR BWR ATOMIC POWER STATIONS. Amano, Makio; Yokoyama, Yoshizumi (Ishikawajima-Harima Heavy Industry Co., Ltd.). Haikan Gijutsu, 9: No. 9, 73-84(Sep. 1967). (In Japanese).

The field piping-work for BWR atomic power stations is described for JPDR, JAPC-II (the Tsuruga atomic power station), and TEPCO-I (the Fukushima atomic power station). Construction includes: planning for the piping work, outline of the BWR pipings, outline of the precesses in the piping work, welding in the piping work, inspections in the piping work, and breakages expected for the pipings. (NSA of Japan)

32852 EMERGENCY COOLING SYSTEMS IN NUCLEAR PLANTS. Brown, W. S. (Dilworth, Secord, Meagher and Associates, Ltd., Toronto). Trans. Amer. Nucl. Soc., 11: 258(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32853 EMERGENCY CORE COOLING FOR HIGH-TEMPERATURE GAS-COOLED REACTORS. Goodjohn, A. J. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc., 11: 258-9(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32854 CONSTRUCTION OF THE TSURUGA ATOMIC POWER STATION. Akino, Kinji (Japan Atomic Power Co., Tokyo). Kenchiku Gijutsu, No. 195, 67-72(Nov. 1967). (In Japanese).

The Tsuruga atomic power station of JAPC, under construction in Fukui Prefecture, employs a BWR type reactor of electric output 325 MW. Construction was started from April 1966 and will be completed in December 1969. The reactor plant is constructed by G. E. of the United States, with other associated buildings, etc., built by JAPC itself. The Tsuruga atomic power station is described with some emphasis on its anti-earthquake structure. Description includes: lay-out of the station, reactor building, turbine building, waste-disposal building, etc., including various facilities and devices in the respective buildings. (NSA of Japan)

32855 JAPC-II NUCLEAR CONTAINMENT VESSEL; DESIGN AND MANUFACTURING. 1. Ishikawajima-Harima Giho, 8: 137-44(Mar. 1968). (In Japanese).

The containment vessel is the first pressure suppression type containment vessel in Japan and is for 322 MWe Tsuruga Nuclear Power Station of the Japan Atomic Power Company. The containment vessel was designed, constructed and tested by IHI based on the engineerings which were developed through the past experience of the construction of JPDR containment vessel for Japan Atomic Energy Research Institute, and the engineerings obtained from Chicago Bridge and Iron Company by technical licence. The function, the construction, the design and the fabrication of the containment vessel are outlined. (NSA of Japan)

32856 RELIABILITY OF ENGINEERED SAFETY FEATURES AS A FUNCTION OF TESTING FREQUENCY. Jacobs, I. M. (General Electric Co., San Jose, Calif.). Nucl. Safety, 9: 303-12 (July-Aug. 1968).

The reliability of an engineered safety system is highly dependent on the frequency of tests performed to demonstrate its operability. Thus the frequency of tests becomes a design consideration of utmost importance. When the system is new, the operator must rely primarily on the designer's recommended test frequency. With actual in-service experience, the operator is able to regulate the test frequencies to attain an overall reliability goal. Under certain limiting conditions, there is clearly an optimum test frequency; more frequent or less frequent testing will degrade reliability. Techniques of modeling have been developed to solve safety-system reliability problems. The models serve as the means to bridge the gap between the uncertainty of design decisions and the stark reality of actual application. (auth)

32857 THE USE OF D_2O STEAM AS COOLANT IN FAST BREEDER REACTORS. Altschuler, S. J. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 274(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32858 DYNAMIC METHOD TO STUDY IN-PILE FISSION-GAS RELEASE. Perez, R. B.; Watson, G. M.; Nelson, P.; Carroll, R. M.; Sisman, O. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 271-2(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32859 SYSTEMS APPROACH TO DESIGN OF ENGINEERED SAFEGUARDS FOR BWR's. Bray, A. P.; Ianni, P. W.; Rogers, A. E. (General Electric Co., San Jose, Calif.). Trans. Amer. Nucl. Soc., 11: 259(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32860 EVALUATION OF BOTTOM FLOODING AS A MEANS OF ARRESTING REACTOR CORE TEMPERATURE TRANSIENTS FOLLOWING A LOSS-OF-COOLANT ACCIDENT. Little, W. S.; Moser, C. M.; Schlenker, L. D. (Phillips Petroleum Co., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc., 11: 260(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32861 EMERGENCY CORE COOLING. Cordle, H. J.; McAdoo, J. D.; Dean, R. A. (Westinghouse Electric Corp., Pittsburgh, Pa.). Trans. Amer. Nucl. Soc., 11: 260-1(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32862 EMERGENCY CORE COOLING IN BABCOCK AND WILCOX PRESSURIZED WATER REACTORS. Wascher, R. E.; Parks, C. E. (Babcock and Wilcox Co., Lynchburg, Va.). Trans. Amer. Nucl. Soc., 11: 261(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32863 CONSTRUCTION OF THE CONTAINMENT BUILDING FOR THE GENTILLY POWER REACTOR. Amyot, Paul (Canadian Nuclear Association, Quebec). Trans. Amer. Nucl. Soc., 11: 262(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32864 SUBATMOSPHERIC CONTAINMENT. Noble, John H. (Stone and Webster Engineering Corp., Boston). Trans. Amer. Nucl. Soc., 11: 262-3(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32865 NEGATIVE PRESSURE CONTAINMENT: PICKERING GENERATING STATION. Kolev, K. D. (Atomic Energy of Canada Ltd., Sheridan Park, Ont.). Trans. Amer. Nucl. Soc., 11: 263-4(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32866 DESIGN AND CONSTRUCTION OF THE OYSTER CREEK CONTAINMENT. Archer, J. C. (Burns and Roe, Inc., Oradel, N. J.); Brown, T. O. Trans. Amer. Nucl. Soc., 11: 264-5(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32867 ICE CONDENSER REACTOR CONTAINMENT SYSTEM. Dragoumis, Paul (American Electric Power Service Corp., New York); Cook, James W.; Weems, Sterling J.; Lyman, Walter G. Trans. Amer. Nucl. Soc., 11: 265(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32868 STEEL-SHELL CONTAINMENT VESSEL WITH CONCRETE SHIELD BUILDING. Corcoran, R. W. (Pioneer Service and Engineering Co., Chicago); Koehler, A. C.; Jensen, Roland J. Trans. Amer. Nucl. Soc., 11: 265-6(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32869 REVIEW OF CONTAINMENT TESTING TECHNIQUES. Swanson, A. Einar (Black and Veatch Consulting Engineers, Kansas City, Mo.); Hinds, John A. Trans. Amer. Nucl. Soc., 11: 266-7(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32870 SYSTEMS CONSIDERATIONS IN THE DESIGN OF SODIUM PUMPS FOR LIQUID-METAL FAST BREEDER REACTORS. Gunson, W. E.; George, J. A.; Horner, H. P.; Goeser, D. K. (Westinghouse Electric Corp., Madison, Pa.). Trans. Amer. Nucl. Soc., 11: 334-5(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32871 PARAMETRIC TWO-DIMENSIONAL ENERGY RELEASE STUDIES OF TWO FAST-REACTOR CORE CONCEPTS. Ball, George L.; Klickman, Alton E.; Yeh, Cheng S.; Wehmeyer, David B. (Atomic Power Development Associates, Inc., Detroit). Trans. Amer. Nucl. Soc., 11: 331(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32872 REACTOR AVAILABILITY DRIVER FUEL INSTRUMENTATION. Fleck, J. (General Electric Co., Schenectady, N. Y.); Riley, D. R. Trans. Amer. Nucl. Soc., 11: 330(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32873 HEAT TRANSFER FROM SMALL HOT SPHERES MOVING THROUGH WATER. Hesson, J. C.; Ivins, R. O. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 327-8(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32874 PREDICTION OF RADIAL FLOW AND TEMPERATURE DISTRIBUTION IN GAS-COOLED REACTOR CORES. Melese-d'Hospital, Gilbert (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc., 11: 328-9(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32875 ON-SITE EXPERIMENTAL INVESTIGATION OF TRANSITION REGIME CORE HEAT-TRANSFER COEFFICIENTS IN THE PEACH BOTTOM HTGR. Lane, R. K.; Petersen, J. F.; Van Howe, K. R. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc., 11: 326(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32876 CRITICAL EXPERIMENTS IN UHTREX. Carmichael, B. M. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc., 11: 323-4(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32877 MEASUREMENTS AND DESIGN MODEL ANALYSIS OF SPACE-CORRELATED REACTOR FLUCTUATIONS. Harris, D. R.; Natelson, M.; Galey, J. A.; Schmidt, E. (Westinghouse Electric Corp., West Mifflin, Pa.). Trans. Amer. Nucl. Soc., 11: 234-5(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32878 EXACT TREATMENT OF NEUTRON FLUCTUATIONS IN REFLECTED SYSTEMS. Sheff, James R. (Battelle-Northwest, Richland, Washington). Trans. Amer. Nucl. Soc., 11: 233 (June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32879 TRANSFER FUNCTION MEASUREMENTS ON ENRICO FERMI FAST REACTOR USING SINGLE REACTIVITY PULSES OF VARIOUS DURATIONS. Batch, M. L.; Klickman, A. E. (Atomic Power Development Associates, Inc., Detroit). Trans. Amer. Nucl. Soc., 11: 229-30(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32880 OPTIMAL ESTIMATION OF SPATIAL POWER PROFILE FROM DETECTOR READINGS. Kyong, Sang Hyon (Bell Telephone Labs., Whippany, N. J.). Trans. Amer. Nucl. Soc., 11: 230-1(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32881 CONTEMPT-PS: A DIGITAL COMPUTER CODE FOR PREDICTING THE PRESSURE-TEMPERATURE HISTORY WITHIN A PRESSURE SUPPRESSION CONTAINMENT VESSEL IN RESPONSE TO A LOSS-OF-COOLANT ACCIDENT. Carmichael, C. F.; Marko, S. A. (Phillips Petroleum Co., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc., 11: 363-4(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32882 NUMERICAL STUDY OF XENON-POWER SPATIAL OSCILLATIONS. Stacey, Weston M. Jr. (General Electric Co., Schenectady, N. Y.). Trans. Amer. Nucl. Soc., 11: 226-7 (June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32883 VERIFICATION OF A XENON SPATIAL STABILITY CRITERION. Hooper, Richard J.; Rydin, Roger A.; Stacey, Weston M. (General Electric Co., Schenectady, N. Y.). Trans. Amer. Nucl. Soc., 11: 227-8(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32884 ANALYTIC REPRESENTATION OF FAST REACTOR FLUX AND IMPORTANCE SPECTRA. Dunn, F. E.; Becker, M. (Rensselaer Polytechnic Inst., Troy, N. Y.). Trans. Amer. Nucl. Soc., 11: 213-14(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32885 OBJECT RETRIEVAL TOOLS FOR THE ENRICO FERMI ATOMIC POWER PLANT REPAIR PROGRAM. Duffy, J. G.; Matte III, J.; Ryan, J. D.; Warberg, H. S. (Atomic Power Development Associates, Inc., Detroit). Trans. Amer. Nucl. Soc., 11: 358-60(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32886 APPLICATIONS OF MONTE CARLO TO PROBLEMS IN REACTOR DESIGN AND EXPERIMENTAL ANALYSIS. Levitt, Leo B. (Atomics International, Canoga Park, Calif.). Trans. Amer. Nucl. Soc., 11: 309-10(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32887 LIQUID-ROD SHUTDOWN SYSTEM. Agazzi, Albert; Broggi, Armando; Galli de Paratesi, Sergio; Ghiurghi, Luciano (EURATOM, Ispra, Italy). Trans. Amer. Nucl. Soc., 11: 338-9(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32888 TEMPERATURE-DEPENDENT KINETICS OF A TWO-DIMENSIONAL CIRCULATING FUEL REACTOR. Kolar, Michael J. (Lewis Research Center, Cleveland); Miraldi, Floro D. Trans. Amer. Nucl. Soc., 11: 222-3(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32889 STABILITY OF A REACTOR WITH ARBITRARY FEEDBACK. Kastenberg, William E. (Univ. of California, Los Angeles). Trans. Amer. Nucl. Soc., 11: 224(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32890 MULTIPARAMETER NOISE ANALYSIS ON THE ENRICO FERMI ATOMIC POWER PLANT. Batch, M. L.; Klickman, A. E. (Atomic Power Development Associates, Inc., Detroit). Trans. Amer. Nucl. Soc., 11: 236-7(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32891 THE USE OF A KALMAN FILTER FOR THE DETERMINATION OF EBWR DYNAMIC CHARACTERISTICS. Habegger, Loren J. (Argonne National Lab., Ill.); Bailey, R. E. Trans. Amer. Nucl. Soc., 11: 237-8(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32892 PRELIMINARY ANALYSIS OF CORE MELTDOWN TRANSIENTS IN A FAST TEST REACTOR. Waltar, A. E.; Little, W. W.; Harris, R. A. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc., 11: 333(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32893 EFFECT OF NEUTRON TRANSMUTATIONS ON THE FISSION-PRODUCT INVENTORY IN A FAST REACTOR. Bunch, W. L. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc., 11: 333-4(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32894 THE PERFORMANCE OF ZIRCONIUM-ALLOY-CLAD UO$_2$ FUEL FOR CANADIAN PRESSURIZED AND BOILING WATER POWER REACTORS. Page, R. D.; Lane, A. D. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Trans. Amer. Nucl. Soc., 11: 9(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32895 OXIDATION AND HYDRIDING OF ZIRCALOY IN NPD REACTOR. Bain, A. S.; LeSurf, J. E. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Trans. Amer. Nucl. Soc., 11: 9-10(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32896 STATUS OF THE WESTINGHOUSE PLUTONIUM RECYCLE PROGRAM. Roll, J. B.; Forscher, F. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc., 11: 10 (June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32897 RELIABILITY OF NUCLEAR GENERATING UNITS. Elston, K. E. (Ontario Hydro, Toronto). Trans. Amer. Nucl. Soc., 11: 6-7(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32898 CHANGES IN LICENSING REGULATIONS. Blakely, J. P. Nucl. Safety, 9: 335-6(July-Aug. 1968).

A compilation of proposed changes, as of April 1, 1968, to licensing regulations is given. Changes are proposed for the following parts of Code of Federal Regulations, Title 10 (10 CFR): 2, 20, 25, 26, 30, 31, 32, 40, 50, 70, 95, 115, 150, and 170. (M.L.S.)

32899 ACTION ON REACTOR AND OTHER PROJECTS UNDERGOING REGULATORY REVIEW OR CONSIDERATION. Blakely, J. P. Nucl. Safety, 9: 326-34(July-Aug. 1968).

A summary of recent AEC regulatory and other actions relating to power reactors is given. These include: Big Rock Point (Docket 50-155), Connecticut Yankee (Docket 50-213), Cooper (Docket 50-298), Crystal River 4(Docket 50-303), Fort Calhoun (Docket 50-285), Humboldt Bay (Docket 50-133), Indian Point 1 (Docket 50-3), Oconee 1, 2, and 3 (Dockets 50-269, 50-270, and 50-287), Prairie Island 1 and 2 (Dockets 50-282 and 50-306), Surry 1 and 2 (Dockets 50-280 and 50-281), and Zion 1 and 2 (Dockets 50-295 and 50-304). 22 references. (M.L.S.)

32900 AEC ADMINISTRATIVE ACTIVITIES. Blakely, J. P. Nucl. Safety, 9: 324-6(July-Aug. 1968).

ACRS comments on the report of the Advisory Task Force on Power Reactor Emergency Cooling are given. Also included are ACRS findings on seismic aspects of reactor safety research. (M.L.S.)

32901 NUCLEAR SAFETY. Volume 9, Number 4. Cottrell, Wm. B.; Jordan, W. H.; Blakely, J. P.; Savolainen, A. W. One of four Quarterly Technical Progress Reviews published for the Division of Technical Information, USAEC. Oak Ridge, Tenn., Oak Ridge National Lab., July-Aug. 1968. 37p. GPO $0.60.

Information, current as of August, 1968, is given on reactor control and instrumentation, consequences of activity release, operating experience, and current events. Separate abstracts are prepared for each of the five papers. (M.L.S.)

For abstracts of individual sections see: 32856, 32898–32900, and 33029.

32902 NUCLEAR POWER REACTORS AND THE DEVELOPING COUNTRIES. Goodwin, Edward C. (Canadian General Electric Co. Ltd., Peterborough, Ont.). Trans. Amer. Nucl. Soc., 11: 4(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32903 THE IMPACT OF NUCLEAR POWER ON SYSTEM PLANNING. Teekman, Henri (Ontario Hydro, Toronto). Trans. Amer. Nucl. Soc., 11: 4-5(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32904 COMPARISON OF US AND CANADIAN SITING PRACTICES. Hake, Guest (Atomic Energy of Canada Ltd., Ottawa). Trans. Amer. Nucl. Soc., 11: 5-6(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32905 DESIGN CHARACTERISTICS OF A 300-MW(e) STEAM-COOLED FAST REACTOR PROTOTYPE. Kilian, P.; Amon, F.; Lill, G.; Kirchenmayer, A. (Allgemeine Elektricitaets-Gesellschaft, Frankfurt am Main). Trans. Amer. Nucl. Soc., 11: 275 (June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32906 CONCEPT SELECTIONS FOR THE WESTINGHOUSE LMFBR DEMONSTRATION PLANT. Beckett, E. F.; Biancheria, A. A.; Graves, H. W.; Gunson, W. E. (Westinghouse Electric Corp., Madison, Pa.). Trans. Amer. Nucl. Soc., 11: 275-7 (June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32907 THE EFFECT OF ^{236}U AND ^{237}Np ON THE VALUE OF URANIUM AS FEED FOR PRESSURIZED WATER POWER REACTORS. Goellner, D. A.; Benedict, M.; Mason, E. A. (Massachusetts Inst. of Tech., Cambridge). Trans. Amer. Nucl. Soc., 11: 33-4(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32908 THORIUM CAN REDUCE POWER COSTS FOR THERMAL AND FAST REACTORS. Lang, L. W. (Douglas United Nuclear Inc., Richland, Washington). Trans. Amer. Nucl. Soc., 11: 38-9(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32909 VANADIUM ALLOYS VS STAINLESS STEEL FOR LMFBR CLADDING: PHYSICS AND ECONOMICS. Edison, G. E.; Whitlow, G. A. (Westinghouse Electric Corp., Madison, Pa.). Trans. Amer. Nucl. Soc., 11: 37-8(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32910 A FUEL-CYCLE ANALYSIS OF A LIQUID-METAL FAST BREEDER REACTOR FOR POWER AND DESALINATION APPLICATIONS. Thompson, Charles A. (Hittman Associates, Inc., Columbia, Md.). Trans. Amer. Nucl. Soc., 11: 36-7(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32911 DESIGNING FOR SAFEGUARDS: EXPERIENCE AT BRADWELL. Kerr, Edward (International Atomic Energy Agency, Vienna). Trans. Amer. Nucl. Soc., 11: 32(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32912 LARGE GAS-COOLED REACTORS FOR US CENTRAL STATIONS. Shiells, D. A. (Bechtel Corp., San Francisco); Brierley, G. Trans. Amer. Nucl. Soc., 11: 32-3(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32913 CONTROL-ROD PROGRAMMING OPTIMIZATION USING DYNAMIC PROGRAMMING. Terney, William B. (Knolls Atomic Power Lab., Schenectady, N. Y.); Fenech, Henri. Trans. Amer. Nucl. Soc., 11: 354-5(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32914 PREDICTIONS AND MEASUREMENTS OF PHYSICS CHARACTERISTICS IN THE DOUGLAS POINT HWR. Pasanen, A. A. (Atomic Energy of Canada Ltd., Sheridan Park, Ont.). Trans. Amer. Nucl. Soc., 11: 353-4(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32915 OPTICAL, LIGHTING, AND PHOTOGRAPHIC EQUIPMENT FOR THE ENRICO FERMI ATOMIC POWER PLANT REPAIR PROGRAM. Harrigan, P. M. (Power Reactor Development Co., Monroe, Mich.); Matte III, J.; Toth, W. L. Trans. Amer. Nucl. Soc., 11: 358(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

Marine and Portable Power Reactors

Refer also to abstract 31056.

32916 (GMAD-3078-8(Vol.2)) MCR PRELIMINARY DESIGN REPORT: SHIELD. (General Motors Corp., Indianapolis, Ind. Allison Div.). July 31, 1964. Contract AT-30-1)-3078. 288p. (EDR-3950(Vol.2)). Dep. CFSTI.

A detailed technical description of the Military Compact Reactor (MCR) shield is presented. A shaped, split shield concept was adopted to reduce individual package weights. Design features are described for a removable shield, consisting of a fixed half-section and two hinged quarter-sections designed to close about the reactor and fixed shutdown shield on the power generation package. The support skid is designed to function as an integral structure with the removable shield assembly and to form a rigid beam assembly with the power generation package. Design criteria are included for MCR fuel, poison, reflector, shield, coolant, and structural materials. (H.D.R.)

32917 (GMAD-3078-8(Vol.3)) MCR PRELIMINARY DESIGN REPORT. VOLUME III. POWER GENERATION. (General Motors Corp., Indianapolis, Ind. Allison Div.). July 31, 1964. Contract AT(30-1)-3078. 530p. (EDR-3950(Vol.3)). Dep. CFSTI.

The Military Compact Reactor (MCR) is a mobile, nuclear powerplant with a power capability of 3 MW(e). The power source is a 15 MW(t), UO$_2$-fueled, unmoderated reactor. The power conversion equipment consists of two open Brayton cycle gas turbines and two 1875 kVa alternators. High mobility is attained by dividing the plant into five packages. Presented is a detailed technical description of the power generation package, which contains the reactor and shutdown shielding, the primary coolant loop, and a self-contained afterheat removal system. (H.D.R.)

32918 (GMAD-3078-13) MCR QUARTERLY TECHNICAL PROGRESS REPORT FOR PERIOD JULY 1–SEPTEMBER 30, 1964. (General Motors Corp., Indianapolis, Ind. Allison Div.). Oct. 30, 1964. Contract AT(30-1)-3078. 242p. (EDR-4016). Dep. CFSTI.

Technical progress in the 3 MW(e) Military Compact Reactor (MCR) development program is described. Areas in which progress is reported include: analyses of reactor and shield preliminary designs, safety analysis of the design, powerplant integration, materials engineering, performance and weight data for the open Brayton cycle engine, electrical system design, plant control and instrumentation design, ceramic and cermet fuel development, critical experiments, primary coolant loop design, and liquid metal coolant technology. (H.D.R.)

32919 (GMAD-3078-22) MCR SHIELD SPECTRUM GENERATOR DESIGN REPORT. Schamberger, R.; Kellman, S.; Silberstein, M. (United Nuclear Corp., White Plains, N. Y. Development Div.). May 3, 1965. Contract AT(30-1)-3078. 99p. (EDR-4188). Dep. CFSTI.

For General Motors Corp., Indianapolis, Ind. Allison Div.

The design of the Shield Spectrum Generator (SSG), a new device proposed as the basis for the principal experimental program for developing a sound MCR shield design is described. In the SSG, a subcritical depleted U cylinder transforms a 14-MeV neutron source, produced by a commercially available neutron generator, into a leakage source whose geometry and energy spectrum are similar to those of small fast reactors similar to the MCR. Reflector and shield regions constructed from building-block materials around this source are capable of representing the important geometric features of the MCR, including coolant ducts and other inhomogeneities. Design calculations are presented which show that the significant sources of radiation dose from the MCR are also present and measurable in a simulated MCR-type shield exposed to the SSG. A program of cylindrical, slab, and duct experiments is outlined which, in conjunction with analytical calculations, should materially reduce the present uncertainties in the design of MCR-type shields. (auth)

32920 (GMAD-3078-23) COMPUTER PROGRAM FOR DETERMINATION OF REACTOR THERMOHYDRAULIC STUDIES FOR MCR PARAMETRIC STUDIES. Weinstein, A.; Morris, R. (United Nuclear Corp., White Plains, N. Y. Development Div.). May 3, 1965. Contract AT(30-1)-3078. 67p. (EDR-4219). Dep. CFSTI.

For General Motors Corp., Indianapolis, Ind. Allison Div.

A digital computer program was written in FORTRAN to compute mechanical design and thermo-hydraulic performance characteristics for MCR-type compact reactors. The code handles pins set on a triangular pitch separated by spiral-wrapped wires which have the same diameter as the minimum spacing between pins. The program allows a fission gas space at the end of each pin. The gas space length and clad thickness are varied automatically in the program to give an optimum design within the clad strength limitations. Provision is made in the program to calculate nominal and hot spot characteristics. The program can treat uniform or orificed flow. (auth)

32921 (GMAD-3078-24) MCR PLANT CONTROL SYSTEM INTEGRATION STUDIES. Powers, J. (General Motors Corp., Indianapolis, Ind. Allison Div.). May 3, 1965. Contract AT-(30-1)-3078. 38p. (EDR-4191). Dep. CFSTI.

A study to integrate the functions of the 3-MW(e) MCR design analog engine and electrical control systems into the MCR digital control computer is described. The feasibility of direct digital control of the engine speed control and the main and house load electrical generating and distribution systems was determined, and digital control loops to perform the indicated control functions were synthesized. (auth)

32922 (GMAD-3078-26) MCR CRITICAL ASSEMBLY SHIELD EXPERIMENTS. Schamberger, R.; Grochowski, G.; Hanfling, R. (United Nuclear Corp., White Plains, N. Y. Development Div.). May 3, 1965. Contract AT(30-1)-3078. 151p. (EDR-4193). Dep. CFSTI.

For General Motors Corp., Indianapolis, Ind. Allison Div.

MCR shield design and analysis techniques were tested by comparing calculations with measurements for experiments simulating major portions of the MCR shield. A split-table critical assembly of the MCR was the radiation source. The analytical methods used were one-dimensional S$_n$ transport theory and both one- and three-dimensional Monte Carlo techniques. Experiments on a cylindrical mock-up of the inner shield regions showed that all of the techniques adequately predict neutron activations and γ heating in the MCR fixed (after-shut-down) shield. Experiments in which rectangular slabs simulated nearly the full radial configuration of the MCR shield yielded neutron and γ ray dose rates closely predicted by the three-dimensional analysis but significantly underestimated by the one-dimensional spherical methods. Further experiments and analyses are required to establish the validity of one-dimensional methods as applied to the near-cylindrical MCR shield and to test engineering shield features not addressed in experiments to date. (auth)

32923 (GMAD-3078-27) MCR CRITICAL EXPERIMENTS PROGRAM. Brooks, W.; Hanfling, R.; Marotta, C. (United Nuclear Corp., White Plains, N. Y. Development Div.). May 3, 1965. Contract AT(30-1)-3078. 172p. (EDR-4194). Dep. CFSTI.

For General Motors Corp., Indianapolis, Ind. Allison Div.

A two-year critical experiments program was performed as part of the Military Compact Reactor (MCR) program to design and develop a mobile, self-sufficient, electric power generating plant of 3 MW(e). The primary objective was to verify the accuracy and applicability of analytical techniques for prediction of neutron parameters in MCR systems. The goal was achieved by comparing the results of critical experiments with analytical computation of these experiments for critical mass, control drum worth, reactivity coefficients, power distribution, and foil activations. Calculations were performed using transport theory techniques in one-dimensional spherical and cylindrical geometry and two-dimensional cylindrical geometry. Four groups of 5-in. thick reflector assemblies were investigated for a single 13-in. dia core geometry of variable fuel loading. The four experimental assembly groups corresponded with the evolution of the MCR reflector design, utilizing reflectors of BeO, stainless steel, W, and combinations, plus several control drum variants. The analytical predictions provide excellent agreement with most of the measured parameters, with some superiority evidenced for the two-dimensional methods. (auth)

32924 (GMAD-3078-30) MCR FUEL-IRRADIATION SUMMARY REPORT. Cihi, J.; Kostman, S.; Rush, D. (General Motors Corp., Indianapolis, Ind. Allison Div.). May 3, 1965. Contract AT(30-1)-3078. 156p. (EDR-4215). Dep. CFSTI.

The objective of the Military Compact Reactor (MCR) Irradiation Test Program was to determine experimentally the suitability of candidate fuels to satisfy the requirements of the MCR, and, for cermet fuels, to fulfill the advantages hoped for them. Although the MCR program had scheduled 40 irradiation capsules prior to accepting a fuel material for fabrication into the first core loading, the results of the initial experiments were so successful, as exhibited by the postirradiation condition of the fuel, that the feasibility of UO$_2$–Nb cermet fuels is felt to have been established. The fifth experiment showed that ceramic UO$_2$ pellets in a Nb–1% Zr clad is an acceptable fuel, though it lacked the special advantages cited for the cermet. As part of the fuel development program for the MCR, ten high-loaded UO$_2$–Nb cermet and two ceramic UO$_2$ specimens were irradiated in five capsules. Irradiation conditions were representative of MCR design conditions. All capsules performed well, running to their full scheduled terms, and all fuel specimens were in excellent condition after irradiation. Lineal specimen growth never exceeded 0.9% and 92 to 99% of all fission gases were retained within the fuel. The microstructure of all cermets was little changed by irradiation although minor cracking did occur. The feasibility of high-loaded UO$_2$–Nb cermets for use in MCR has been established. (auth)

32925 (GMAD-3078-31) MCR SAFETY AND MATERIALS STUDIES. Summary of FY 65 Activities. Dunenfeld, M.; Goldstein, L.; Tsareff, T. (General Motors Corp., Indianapolis, Ind. Allison Div.). May 3, 1965. Contract AT(30-1)-3078. 75p. (EDR-4216). Dep. CFSTI.

The 3-MW(e) MCR safety design criteria were revised and expanded. Calculations indicate that scram delays of 1 and 3 sec for the loss of pump power and mobile situation maximum credible accidents will not result in any significant change in safety. It was shown that (1) control drum dynamics provide scram protection for a 90¢ step insertion of reactivity and (2) that diffusion of air into an opening in the primary loop does not cause oxide plugging during the required operating time of the afterheat removal system. Comprehensive UO_2 cermet- and PuO_2-fueled core reactivity transient data were generated. Materials and optimum fabrication processes were selected, based on engineering studies of the heat exchanger, fuel, primary loop compatibility, shield, power conversion, and skid materials. Potassium leak tests gave evidence that plugging of small leaks may occur up to temperatures around 450°F. Versatile equipment to generate low cycle fatigue data was selected. Lead-lead oxide dispersions were found to have creep and tensile strength properties superior to reported values for lead. (auth)

32926 (GMAD-3078-32(Vol.2)) MCR LIQUID METAL TECHNOLOGY SUMMARY REPORT. Hyman, N.; Kostman, S.; McKee, J. (General Motors Corp., Indianapolis, Ind. Allison Div.). May 3, 1965. Contract AT(30-1)-3078. 154p. (EDR-4217(Vol.2)). Dep. CFSTI.

Corrosion in Nb-1% Zr, type 316 stainless steel (SS), potassium systems was experimentally evaluated under laboratory conditions intended to simulate the MCR. Thirty-one thermal convection loops and one forced circulation loop were utilized. Loop operation of 115,000 hr had been accumulated at termination of the MCR program. Twelve loops operated at 1600°F maximum potassium temperature for at least 5000 hr. Some of the effects of major variables, such as maximum temperatures, potassium purity, velocity, Reynolds number, and surface area ratios, were evaluated. This evaluation indicated that Nb-1% Zr and 316 SS may be satisfactory materials for MCR fuel cladding and primary system containment, respectively. Surface removal rates, based on gross weight change data from Nb-1% Zr in thermal convection loops, can be held to less than 0.1 mil/year by maintaining a low oxygen content in the potassium. Carbon and nitrogen are transferred by the potassium from the stainless steel to form reaction layers on the Nb-1% Zr. Diffusion of carbon and nitrogen into the matrix is sufficiently slow in thermal convection loops to maintain adequate structural properties up to 1600°F for 5000 hr. Hot end stainless steel surface removal rates, as indicated by gross weight change data, are less than 1 mil/year. Deeper intergranular penetration was observed in some localized heater areas. Room temperature tensile testing of sections from a thermal convection loop, which operated for 14,000 hr, indicated that the 316 SS remained ductile. (auth)

32927 (GMAD-3078-33) MCR PRIMARY LOOP HEAT EXCHANGER DEVELOPMENT REPORT. Hulbert, D.; Schechter, B. (General Motors Corp., Indianapolis, Ind. Allison Div.). May 3, 1965. Contract AT(30-1)-3078. 83p. (EDR-4218). Dep. CFSTI.

Component fabrication development studies were performed to develop a compact, high-temperature, liquid metal-to-air heat exchanger, for the Military Compact Reactor (MCR) primary loo The development program conducted on component hardware and pilot model test heat exchangers for the MCR application is described. Two test heat exchangers accumulated a total in excess of 6000 hr of high-temperature operation, including an extended operating period of over 4700 hr without failure. Design of critical areas, such as tube-to-header weld joints, and further efforts necessary to develop component hardware which will satisfy the criteria of extended life and high reliability are discussed. (auth)

32928 (NDA-2143-9) MILITARY COMPACT REACTOR PROGRAM: AN INVESTIGATION OF HIGH ENERGY CAPTURE GAMMA RADIATION. Schamberger, R. (Nuclear Development Corp. of America, White Plains, N. Y. General Motors Corp., Detroit, Mich.). May 30, 1961. Contract AT(30-1)-2303. 50p. Dep. CFSTI.

Experiments were performed using a Po-Be neutron source to determine the rate of radiative capture in materials of interest for the MCR shield as a function of the degree of boration of a hydrogenous material adjacent to the sample and, in the case of steel, as a function of the degree of boration of the material itself. The results are presented in a form which is useful in the analysis of lid tank experiments and in the estimation of capture gamma production from these materials in shield design calculations. Analysis of the data indicates that the principal capture resonances in stainless steel lie between 100 eV and 10 keV. Thus, it should be possible to suppress the gamma source associated with capture of neutrons slowing down in stainless steel by heavy boration. (auth)

32929 (NDA-2143-13) DOPPLER COEFFICIENTS FOR MCR-TYPE CORES. Tralli, N. (United Nuclear Corp., White Plains, N. Y. Development Div.). July 18, 1961. Contract AT(30-1)-2303. 38p. Dep. CFSTI.

Calculations have been performed to estimate the Doppler coefficient of reactivity for the MCR concept. Over the range of enrichments, $N(25)/N(U) \geq 0.5$, and hydrogen concentration, $N(H)/N(U) \leq 2.2$, the Doppler coefficient becomes more negative with increasing hydrogen concentration and decreasing enrichment. Doppler coefficients of reactivity in the range from -10^{-6}/°K to -10^{-5}/°K were obtained. (auth)

32930 (NDA-2143-15) MILITARY COMPACT REACTOR PROGRAM STUDIES IN THE SYNTHESIS OF MINIMUM WEIGHT SHIELDS. Troubetzkoy, E. S.; Kalos, M. H. (United Nuclear Corp., White Plains, N. Y. Development Div. General Motors Corp., Detroit, Mich.). Aug. 7, 1961. Contract AT(30-1)-2303. 44p. Dep. CFSTI.

Simple approximate equations for the attenuation of neutron and gamma radiation with secondary production are introduced. Mathematical techniques are given for minimizing the weight subject to the constraints that the emerging neutron and gamma doses are prescribed and that the shield materials are to be chosen from a given set. The application of these techniques leads to rules which substantially reduce the number of materials, and restrict the arrangement and mixtures of these materials to be used. The methods have been applied to the rearrangement of a portion of a previously designed shield and lead to an encouraging reduction in weight. (auth)

32931 (TID-21091) THE REFERENCE MCR CONTROL DRIVE BASIS. Hulbert, D. I. (General Motors Corp., Indianapolis, Ind. Allison Div.). Sept. 11, 1964. Contract AT-(30-1)-3078. 17p. Dep. CFSTI.

The general layout of the 2 to 3 MW(e) Military Compact Reactor and the major plant objectives that result in design constraints affecting the control drive configuration are presented. The design drive mechanism requirements and control drum characteristics are discussed. (H.D.R.)

32932 KOMPONOVKA I RASCHET REAKTOROV SUDOVYKH YADERNYKH USTANOVOK. (Layout and Design of Marine Nuclear Reactors). Kuznetsov, Vladimir Aleksandrovich. Moscow, Izdatel'stvo Transport, 1966. 218p.

Presented is a textbook intended for the course "Marine Nuclear Reactors," offered by higher marine engineering institutes and by the Odessa Institute of Marine Engineers. It can also be used by ship's mechanics engaged in the operation of marine nuclear reactors. It gives a systematic presentation of the basic types of marine nuclear reactors, their design, parameters, materials used, and auxiliary systems. (ATD)

Rocket and Space Reactors

Refer also to abstract 30925.

32933 (CONF-680508-2) MULTIMEGAWATT THERMIONIC REACTOR SYSTEMS FOR SPACE APPLICATIONS. Sawyer, C. D.; Hill, P. R.; Wilkins, D. R. (General Electric Co., Pleasanton, Calif. Nuclear Thermionic Power Operation). [1968]. 13p. Dep. CFSTI.

From 2nd International Conference on Thermionic Electrical Power Generation, Stresa, Italy.

A review of selected portions of the General Electric Company thermionic reactor development program is presented. Typical design features and performance characteristics of thermionic reactors with electrical ratings in the multimegawatt class are presented by reference to the results of a reactor design study carried out for a hybrid nuclear rocket/nuclear electric Mars mission. Important elements of related technology from other elements of the General Electric program are also presented. In particular, a summary of the results of a thermionic reactor critical experiment and the results of preliminary reactor stability studies is discussed. (auth)

32934 (NAA-SR-12038) S8DR TEMPERATURE SWITCH DEVELOPMENT AND TESTING. Powers, J. L. (Atomics International, Canoga Park, Calif.). May 15, 1968. Contract AT(04-3)-701. 17p. Dep. CFSTI.

A temperature switch is described which operates in conjunction with a platinum resistance temperature detector to provide the input signals to control the SNAP 8 Reactor. The results of a testing program which demonstrated the suitability of the device for the SNAP Developmental Reactor (S8DR) use are also described. (auth)

32935 (SAN-679-5) DESIGN STUDY [OF] ELECTRICAL COMPONENT TECHNOLOGY FOR 0.25 TO 10.0 MEGAWATT SPACE POWER SYSTEMS. PARAMETRIC DESIGN STUDY OF CANNED AC INDUCTION MOTORS. Allen, T. C. (Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.). Dec. 15, 1967. Contract AT(04-3)-679. 134p. Dep. CFSTI.

Parametric studies of canned ac induction motors for prime movers of centrifugal pumps for space nuclear electric power plants utilizing the Rankine conversion cycle is presented. The parametric data is suitable to determine minimum system weight as a function of shaft horsepower rating, frequency, synchronous speed, voltage, and coolant temperature for ratings between 5 and 250 horsepower. (auth)

32936 LIQUID JET SUPER FLUX REACTOR (LJSFR). King, L. D. P. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc., 11: 351(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32937 METHOD FOR CALCULATING THE REACTIVITY WORTH OF EXTERNAL SHIELDS AND STRUCTURES USING MONTE CARLO-COUPLED-TRANSPORT CALCULATIONS. Salah, S.; Doncals, R. A. (Westinghouse Astronuclear Lab., Pittsburgh). Trans. Amer. Nucl. Soc., 11: 164-5(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32938 CRYOGENIC RADIATION EFFECTS ON NERVA STRUCTURAL ALLOYS. Dixon, C. E.; Stadig, J. E.; Funk, C. W. (Aerojet-General Corp., Sacramento, Calif.). Trans. Amer. Nucl. Soc., 11: 149(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32939 REDUCTION OF FISSION-DENSITY SPIKING AND NUCLEAR SAFETY IN FAST SPACE REACTORS BY MEANS OF THIN NEUTRON FILTERS OF EUROPIUM COMPOUNDS. Hampel, Viktor E.; Hansen, Virginia (Univ. of California, Livermore). Trans. Amer. Nucl. Soc., 11: 27-8(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32940 SOLUTION FOR THE TEMPERATURE DISTRIBUTION IN GASEOUS-FUELED CAVITY REACTORS. Johnson, Mikkel B.; Gritton, Eugene C. (Rand Corp., Santa Monica, Calif.). Trans. Amer. Nucl. Soc., 11: 28-9(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32941 INDIRECT MEASUREMENT OF NUCLEAR HEATING RATES IN POISON CONTROL VANES. Friedman, S. T.; Rankin, W. D. (Westinghouse Astronuclear Lab., Pittsburgh). Trans. Amer. Nucl. Soc., 11: 25(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32942 PROPELLANT RADIATION HEATING AND PAYLOAD DOSE PREDICTIONS FOR NERVA NUCLEAR ROCKET SYSTEMS. Warman, E. A.; Rogers, D. R.; Koebberling, K. O.; Pasternak, T. (Aerojet-General Corp., Sacramento, Calif.). Trans. Amer. Nucl. Soc., 11: 25-6(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32943 NUCLEAR ANALYSIS OF A COLLOID-FUELED CAVITY REACTOR. Stefanko, J. S. (Westinghouse Astronuclear Lab., Pittsburgh). Trans. Amer. Nucl. Soc., 11: 17-18(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32944 USAEC SPACE NUCLEAR ELECTRIC POWER PROGRAM: ITS OBJECTIVES AND STATUS. Newby, Glen A. (United States Atomic Energy Commission, Washington, D. C.). Trans. Amer. Nucl. Soc., 11: 13(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32945 THERMIONIC HEAT PIPE SPACE POWER CONCEPT. Anderson, John L. (Lewis Research Center, Cleveland). Trans. Amer. Nucl. Soc., 11: 14(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32946 NUCLEAR CALCULATIONS ON THERMAL THERMIONIC REACTOR SYSTEMS FOR SPACE. Emendoerfer, D.; Haug, W.; Pruschek, R.; Roehrborn, B.; Unger, H.; Wolf, E. (Univ. of Stuttgart). Trans. Amer. Nucl. Soc., 11: 14-15(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32947 CAVITY REACTOR ENGINEERING MOCKUP CRITICAL EXPERIMENT. Pincock, G. D. (General Electric Co., Idaho Falls, Idaho); Kunze, J. F.; Wood, R. E.; Hyland, R. E. Trans. Amer. Nucl. Soc., 11: 29-30(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32948 MAGNETIC DIFFUSION IN A VORTEX GAS CORE NUCLEAR ROCKET ENGINE. Dupree, S. A. (Purdue Univ., Lafayette, Ind.); Sandmeier, H. A. Trans. Amer. Nucl. Soc., 11: 30(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32949 ACOUSTIC INSTABILITY IN A FISSION GAS. McNeill, H.; Becker, M. (Rensselaer Polytechnic Inst., Troy, N. Y.). Trans. Amer. Nucl. Soc., 11: 31(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32950 STUDY OF FLOW-INDUCED VIBRATIONS OF A PLATE IN NARROW CHANNELS. Bland, S. R.; Rhyne, R. H.; Pierce, H. B. (NASA Langley Research Center, Hampton, Va.). J. Eng. Ind., 89: 824-30(Nov. 1967).

From Vibrations Conference, Boston, Mass. See CONF-670332.

Vibrational phenomena associated with narrow channel flow have come under study as a result of the core failure of an early nuclear rocket engine. Since the mechanism of this vibration instability was not well understood at the time of failure, an investigation of a simple system consisting of a rigid plate with two degrees of spring-restrained freedom in a two-dimensional channel has been made both experimentally and analytically. The results show a strong dependence of the flow rate required for plate oscillation on the channel width (normal to plate). (auth)

32951 REACTOR IN AN AIRCRAFT [ATOMIC POWERED AIRCRAFT]. Jankiewicz, Z. Zolnierz Pol., No. 39, 13(1967). (In Polish).

A study has been made of the use of atomic energy in aircraft propulsion. The following four possible methods of accomplishing this are mentioned: a rocket engine in which liquid hydrogen is converted to gas and used as a propellant; a ramjet engine, in which air passes through a reactor chamber, here it is heated, producing an exhaust which creates thrust; a turbojet engine, also working on the principle of taking in and heating air; and a turboprop engine, in which the engine's source of power is water heated in an atomic reactor and converted to steam; the steam goes through a multistage turbine to turn the propeller, and is later condensed, and returned to the reactor. The powerplant may also consist of a combination atomic reactor for high altitude flying and a jet engine for takeoff and landing. Any of the above methods could be used to build an aircraft with a 100,000-hp power plant, and the weight of such an aircraft would be approximately 100–150 tons. Artist concepts of a Soviet nuclear powered aircraft are shown. (JPRS)

32952 EXPERIMENTAL EXPLORATION OF RECIRCULATION ZONE IN THE GAS-CORE NUCLEAR ROCKET CONCEPT. Chang, C. C.; Chi, S. W.; Chen, C. M. (Catholic Univ. of America, Washington, D. C.). J. Spacecraft Rockets, 5: 480-1(Apr. 1968).

A smoke visualization technique was used for observations of the secondary flow pattern inside and outside the recirculation zone in a model of a cylindrical gas-core nuclear rocket cavity. Experiments using freon and helium to represent fuel and propellant and a simple transient technique indicated that the fuel dwells in the recirculation zone 120 to 240 times as long as the propellant in the cylindrical cavity. (H.D.R.)

32953 STABILITY OF NUCLEAR ROCKET ENGINE DYNAMICS. Wiberg, Donald M.; Woyski, Jan S. (McDonnel Douglas Corp., Santa Monica, Calif.). Nucl. Appl., 5: 35(July 1968).

Analog computer and theoretical results are presented to show the nonlinear stability of any steady-state propellant temperature and flow in a typical nuclear rocket engine. This assurance of stability encourages design of schemes in which the neutronics are not closely controlled, e.g., schemes involving only propellant flow control or on-off drum controllers. A detailed analog computer model was assembled and checked against experimental data. Step-by-step approximations were made to simplify the nuclear engine dynamic behavior. This process continued until a small number of equations were found that adequately described this behavior and were amenable to theoretical analysis. For locked control behavior described by simplified theoretical equations, very large transients are proven to be stable. For the general theoretical case, only preliminary results are now available, but computer results indicate equally stable behavior. (auth)

Process Heat and Desalination Reactors

32954 METALLIC-URANIUM-FUELED PWR FOR SINGLE-PURPOSE DESALTING. Anderson, T. D.; Chapman, R. H.; Jones, J. E.; Podeweltz, C. M. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 355-6(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32955 NUCLEAR DUAL-PURPOSE POWER-DESALINATION PLANT: BRINE HEATER LEAKAGE CONTROL STUDY. Kelley, W. H. Jr. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 356-7(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32956 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. de Paravicini, Thomas Pitt (to United Kingdom Atomic Energy Authority). British Patent 1,114,709. May 22, 1968. Filed Oct. 16, 1964.

A nuclear reactor and its operating procedure are described for heating liquid coolant(s) in two successive stages. The reactor core is divided into at least one main section and one minor section, which are separated by a space that can be filled or emptied of a neutron controlling substance such as a moderator. When the space is empty, the major section of the core drives the minor section neutronically and when filled with the substance, the sections are neutronically decoupled. The major portion of the core serves to heat the liquid coolant to boiling, and it is then superheated in the minor section. (B.L.M.)

Research and Test Reactors and Critical Assemblies

Refer also to abstracts 30583, 30826, 30890, 31348, 32451, 32453, 32562, 32575, and 32589.

32957 (AAEC/TM-418) THE RELEASE, EFFECT, AND FATE OF RADIONUCLIDES IN AQUEOUS REACTOR SYSTEMS. Palmer, A. R.; Ryan, H. F.; Smythe, L. E. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nov. 1967. 24p. Dep.

Present knowledge on the release, effect and fate of radionuclides in water-cooled reactor systems is summarised and related to practical operational problems. It is shown that present corrective decontamination measures for coolant circuits are not promising and that early diagnosis of faulty fuel elements and their prompt removal is the best insurance against operational problems. 52 references. (auth)

32958 (AHSB(S)Handbook-5(Pt.2)) HANDBOOK OF EXPERIMENTAL CRITICALITY DATA. PART 2. CHAPTERS 5 AND 6. Abbey, F. (comp.) (United Kingdom Atomic Energy Authority, Risley (England). Authority Health and Safety Branch). 1968. 124p. Dep. CFSTI. UK.

Criticality data are tabulated for: single ^{235}U cores moderated by hydrogen and single Pu cores moderated by hydrogen. The results for highly enriched systems are categorized according to: unreflected spheres of aqueous UO_2F_2 and $UO_2(NO_3)_2$ and spherical systems reflected with water and polyethylene; aqueous cylindrical systems—both reflected and unreflected; reflected and unreflected aqueous parallelepiped cores; uranium metal cores diluted with lucite and with lucite-graphite; and annular cylindrical aqueous cores. The results for low and intermediate enrichment systems are categorized as: bare aqueous cores of spherical, cylindrical, and rectilinear parallelepiped configurations; single material reflected systems; and composite reflectors. Criticality data for heterogeneously poisoned aqueous systems are tabulated. Pu fueled aqueous systems are categorized according to spherical, cylindrical, or parallelepiped. 57 references. (M.L.S.)

32959 (ANL-7310, pp 1-30) FISSION PROPERTIES AND CROSS SECTION DATA. (Argonne National Lab., Ill.).

NEUTRON CROSS SECTIONS—calculations of elastic-scattering average and energy-dependent, mean square deviations for; vanadium elastic and inelastic differential, measurement of; palladium elastic differential, measurement of; germanium elastic and inelastic measurement of; measurement of tantalum and rhenium scattering fast; autocorrelation function determination from total; compilation for magnesium, titanium, vanadium, molybdenum, and gadolinium, ENDF/B

FLUORINE—neutron elastic and inelastic scattering from, measurement of; neutron total cross section for

PALLADIUM—neutron elastic scattering from, measurements of fast

NEUTRONS—scattering of, polarization measurements in elastic; reactions (n,n′γ) with germanium-74, excitation function for gamma ray production in; fission yield of, mass dependence of anisotropy of

VANADIUM—neutron elastic scattering from, measurement of; neutron total cross section for; neutron cross sections for, compilation of ENDF/B

TANTALUM—neutron elastic scattering differential cross sections for, measurement of fast; neutron inelastic excitation cross sections for, measurement of fast; neutron total cross sections for, measurement of fast; neutron total cross section for

RHENIUM—neutron total cross sections for, measurement of fast

ZINC—neutron total cross section for

SODIUM—neutron total cross section for

CARBON—neutron total cross section for

LITHIUM ISOTOPES Li-6—neutron total cross section for

LITHIUM ISOTOPES Li-7—neutron total cross section for; proton reactions (p,n), integrated cross section for

GERMANIUM—neutron elastic and inelastic scattering from, measurement of; neutron total cross section for

YTTRIUM—neutron total cross section for

GERMANIUM ISOTOPES Ge-74—neutron reactions (n,n′γ), excitation function for gamma ray production in

URANIUM ISOTOPES U-235—neutron reactions (n,f), mass-angle-energy correlation in thermal; fission of, total kinetic energy of fragments from

NEUTRONS, THERMAL—reactions (n,f) with uranium-235, mass-angle-energy correlation in; reactions (n,α) with neon-21, total absorption cross section for

PROTONS—reactions (p,n) with lithium-7, integrated cross section for

NEON ISOTOPES Ne-21—neutron reactions (n,α), total absorption cross section for thermal

AMERICIUM ISOTOPES Am-241—half-life measurements for, use of fission track counting technique for spontaneous fission

MAGNESIUM—neutron cross sections for, compilation of ENDF/B

TITANIUM—neutron cross sections for, compilation of ENDF/B

MOLYBDENUM—neutron cross sections for, compilation of ENDF/B

GADOLINIUM—neutron cross sections for, compilation of ENDF/B (M.L.S.)

32960 (ANL-7310, pp 31-135) THERMAL REACTOR PHYSICS. (Argonne National Lab., Ill.).

CRITICAL ASSEMBLIES—cadmium ratio measurements in high conversion uniform lattice, gold and indium

GOLD—cadmium ratios for, measurement in high conversion uniform lattices of; cadmium ratios for, determination of neutron temperature and epithermal index from activation

URANIUM ISOTOPES U-235—neutron cross sections for, effects on reactivity of variation of; cadmium ratios for, determination of neutron temperature and epithermal index from activation

INDIUM—cadmium ratios for, measurement in high conversion uniform lattices of

URANIUM ISOTOPES U-238—neutron cross sections for, effects on reactivity of variation of

REACTIVITY—neutron cross section variation effects on, uranium-235 and uranium-238; temperature effects on AARR excess; insertion accidents in AARR, analysis of; transients in AARR, summary of reactor responses to

EXPERIMENTAL BOILING WATER REACTOR—poisoning for, reactivity worth of boric acid; control rods for, reactivity worth of; temperature coefficient of reactivity for, measurement of uniform; plutonium recycle experiment in, power operation history of; plutonium fuel loading in, measurement of capture-to-fission ratio of plutonium-239 and plutonium-241 in; cadmium ratio measurements in, test conditions for

BORIC ACID—reactivity worth of EBWR

REACTOR CONTROL ELEMENTS—reactivity worth of EBWR

CAPTURE-TO-FISSION RATIOS—measurement of plutonium-239 and plutonium-241, in EBWR plutonium fuel loading

REACTORS, THERMAL—physics characteristics of plutonium fueled, summary of

ARGONNE ADVANCED RESEARCH REACTOR—core loadings for, measurements on mockups of; fuel elements for, design

parameters of; mockup of, description of critical; thermal column in simulated, calculation of absolute fluxes in internal; power determinations for, use of activation foils for; thermal columns in, radial traverses of uranium-235 fission activity through beryllium liners for; core mockup for, use of uranium-aluminium wires for measuring uranium-235 fission distribution and power densities in; thermal column for simulated, techniques for measurement of thermal neutron temperatures in; thermal column in simulated, reactivity coefficients of beryllium and teflon in internal; thermal column in simulated, reactivity effect of voids in internal; reactivity measurements in simulated, radial traverses of small sample; control blade for, reactivity worths of; beam tubes for, neutron yield optimization measurements for; beam tubes for, reactivity worths of; core intervals for simulated, effects on neutron distributions of; gamma heating measurements in simulated, use of manganese-activated calcium fluoride for; neutron lifetime measurements in simulated, use of Rossi-α and pulsed neutron techniques for prompt; diffusion theory analyses of, multigroup partitions of neutron energy range for; thermal column for, calculated reactivity effects of aluminum and 1/v-target poisoning in internal; reflector for calculated reactivity and thermal flux perturbations by neutron poisons in beryllium; core for, calculated fission neutron production rate, and fission power density in cold-clean; thermal column for, calculated neutron flux distributions in internal; thermal column for, spectral variation of relative thermal neutron capture rate in internal; shielding for, general design analysis of; reactivity insertion accidents in, analyses of; reactivity transients in, summary of reactor responses to; radiation dose rates following maximum credible accident in, analysis of biological; containment system for, calculations of leakage rates from, siting of, safety analysis of
NEUTRON CROSS SECTIONS—variations in uranium-235 and uranium-238, effects on reactivity of; determination of AARR internal thermal column effective group
INDIUM ISOTOPES In-115—cadmium ratios for, determination of neutron temperature and epithermal index from activation,
LUTETIUM ISOTOPES Lu-176—cadmium ratios for, determination of neutron temperature and epithermal index from activation
LUTETIUM ISOTOPES Lu-175—cadmium ratios for, determination of neutron temperature and epithermal index from activation
MANGANESE—cadmium ratios for, determination of neutron temperature and epithermal index from activation
BERYLLIUM—reactivity coefficient for, measurement in AARR thermal column of
TEFLON—reactivity coefficient for, measurement in AARR thermal column of
RADIATION DOSIMETERS, THERMOLUMINESCENT—gamma heating measurements in AARR mockup using manganese-activated calcium fluoride
RADIATION DETECTORS, PROPORTIONAL—response curves for AARR boron trifluoride, effects of position on
ANTIMONY ISOTOPES Sb-124—neutron cross section determination for, use of bare and cadmium-covered foils for
REACTOR CONTAINMENT SYSTEMS—leakage rate calculations for AARR
REACTOR SAFETY—safety analysis of AARR (M.L.S.)

32961 (ANL-7310, pp 377-430) EXPERIMENTAL TECHNIQUES AND FACILITIES. (Argonne National Lab., Ill.).

RADIATION DETECTORS, ACTIVATION—preparation of plutonium-239 and plutonium-241, for EBWR capture-to-fission measurements; manganese bath-type, design of fast neutron detecting; manganese bath-type, description of on-line computer for use with
EXPERIMENTAL BOILING WATER REACTOR—capture-to-fission measurements in, preparation of plutonium-239 and plutonium-241 foils for
PLUTONIUM ISOTOPES Pu-239—activation detectors of, preparation for capture-to-fission measurements in EBWR of
PLUTONIUM ISOTOPES Pu-241—activation detectors of, preparation for capture-to-fission measurements in EBWR of
ARGONNE THERMAL SOURCE REACTOR—fission rate measurements in, fission track counting method for
REACTORS, RESEARCH—neutron detection system for CP-5, description of manganese bath
EXPERIMENTAL BREEDER REACTOR-II—sodium coolant flow in, transport of decaying activity through laminar and turbulent
REACTORS—coolant flow in, equations for transport of decaying activity through laminar and turbulent
REACTOR SAFETY—detection systems for, logic circuits for transient
RADIATION DETECTORS—reactor safety transient systems of, efficiency of
GAMMA SPECTROMETERS—scintillator-junction detector for recoil time resolution of sodium iodide
COINCIDENCE CIRCUITS—resolution of fast sodium iodide scintillation, time
PULSE DISCRIMINATORS—design of versatile gated adjustable paralysis, for fast-slow coincidence experiments
PLUTONIUM—contamination from, design of monitor for detecting airborne
RADIATION DETECTORS, SEMICONDUCTOR (GERMANIUM)—plutonium contamination monitoring system using, design of airborne
RADIATION DETECTORS, SCINTILLATION—resolution of fast coincidence sodium iodide, time; design of fast reactor noise, computer-input circuits utilizing
COMPUTERS—cathode-ray tube display for DDP-24, design of; paper tape circuits for, modifications for; input circuitry for fast reactor noise analysis; multiplexing system for on-line, logic diagram for; reactor control using on-line, design of remote data acquisition system for
CRITICAL ASSEMBLIES—operation of ZPR-9, use of on-line DDP-24 computer for; control algorithm for, development of linearized sampled-data
REACTOR CONTROL SYSTEMS—algorithm for zero-power, development of linearized sampled-data; data acquisition system for, design of on-line computer input remote
ALGORITHMS—development of linearized sampled-data, for zero-power reactor control systems
REACTORS, FAST—noise analysis for, use of polarity cross correlation technique for; noise analyses for plutonium fueled, use of integrating sampler for
PULSE INTEGRATORS—response of DDP-24 on-line computer; reactor noise analyses using, plutonium fueled fast
DATA ACQUISITION SYSTEMS—design of on-line computer remote input
RADIATION TARGETS—design of high intensity gas
NEUTRONS—precession of, design of solenoid for; elastic scattering of, calibration of solenoid for
MAGNET COILS—use for neutron spin precession
PARTICLE SOURCES—performance of pulsed and bunched ion (M.L.S.)

32962 (BNL-12460) INVESTIGATING COMMITTEE REPORT OF THE NITRATE RESIN BED ACCIDENT AT THE BROOKHAVEN HIGH FLUX BEAM REACTOR. Tichler, Paul; Baker, Leonard; Isler, Robert; Metz, Donald (Brookhaven National Lab., Upton, N. Y.). May 7, 1968. 31p. Dep. CFSTI.

The investigation of an explosion on the Equipment Level of the High Flux Beam Reactor Building on July 23, 1965, is described. The explosion occurred in an ion exchange vessel filled with nitrate resin, which will be used to adjust the acidity of the HFBR primary heavy water. The resin bed was being contacted with $2\underline{N}$ HNO_3 solution to reduce the chloride concentration, and it was concluded the explosion resulted from a reaction between the resin and the nitric acid, the concentration of which exceeded the expected value of $2\underline{N}$. (H.D.R.)

32963 (BNL-12476) EXPERIMENTAL EVALUATION OF THE HFBR EMERGENCY COOLING SYSTEM. Tichler, Paul R.; Hill, Frank B. (Brookhaven National Lab., Upton, N. Y.). Apr. 1963. 33p. Dep. CFSTI.

A series of experiments has been carried out to determine the feasibility of the HFBR flow reversal and natural circulation scheme for the removal of fission product afterheat under emergency conditions. The tests were performed with electrically heated nickel channels representing the core, a ball valve and orifice representing the flow reversal valve, and auxiliary piping and equipment to simulate other pertinent structures in the reactor vessel. Results are discussed. (auth)

32964 (BNWL-707) ANALOG-HYBRID DYNAMIC SIMULATION OF THE FFTF REACTOR AND HEAT TRANSPORT SYSTEM. Flowers, C. D.; Gerhardstein, L. H. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 1968. Contract AT(45-1)-1830. 101p. Dep. CFSTI.

A mathematical model has been developed for investigating the dynamic response and control characteristics of the Fast Flux Test Facility (FFTF) Reactor and heat removal systems. The model was developed for solution on the analog-hybrid computer facility at Pacific Northwest Laboratory (PNL). The mathematical modeling techniques used to simulate each system component are discussed in detail, and sample transient results are presented. Prospective uses of the simulation are also discussed. One complete heat removal circuit (out of four) is simulated, and the total heat is accounted for by a multiplying factor. The reactor simulation includes point kinetics with temperature feedbacks, single-node representation of fuel, coolant, leakage, and reflector regions, and inlet and outlet mixing plenums. Multinode heat exchanger models are employed to represent the intermediate and air-dump heat exchangers. The system model also includes simulation of coolant transport time lags, sodium pumps, motors, electromagnetic clutches, air fans, and sodium and air hydraulics. (auth)

32965 (DUN-SA-68) DESIGN CONCEPTS: COMMUNICATIONS FOR THE FAST FLUX TEST FACILITY. Hoffman, R. C. (Douglas United Nuclear, Inc., Richland, Wash.). Apr. 20, 1968. Contract AT(45-1)-1857. 18p. (CONF-680502-3). Dep. CFSTI.

From 6th IEEE Region Conference, Portland, Ore.

The communications equipment design concepts for the proposed Fast Flux Test Facility consists of a coordinated array of systems selected to provide highly reliable independent audio and video systems. The more important features include dial telephones, equipment monitoring, TV inspection video tape recorders, and be available at all times with features for conferences, remote control of TV cameras, dictation, alarms, remote inspection, data acquisition, and data processing. The important process and test locations are covered by two or more compatible, nonredundant, independent systems which can function independently as alternate communications. The focal point of all communication systems is the reactor control room. The required communication systems are available at key operating, maintenance, testing, and study locations. The design concepts are based on more than 20 years of operating experience with Richland Operations reactors and surveys of other reactor plant experiences. These design concepts describe easily used and reliable communications systems for a modern nuclear reactor plant. (auth)

32966 (EUR-3915) ANALYSIS OF ACCIDENTS IN PULSED FAST REACTORS: COMPUTER PROGRAMMES DOPPELAS AND SOREX 1. Randles, J. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Feb. 27, 1968. 41p. Dep.

Some of the main accident situations considered in the analysis of pulsed fast reactor safety are outlined and the accompanying physical conditions are discussed. It is suggested that accidents may be divided into four broad types while the nuclear excursions triggered by these accidents may be put into two classes depending on the magnitude of the fuel temperature rise. The class to which an excursion belongs determines the physical theory used to describe it, since the dominant reactivity feedback mechanisms will be different for a large than for a small temperature rise. The type of accident, on the other hand, determines only the form of the reactivity input. Two theories dealing with the two classes of nuclear excursions are sketched and two FORTRAN 4 computer programmes based on these theories are explained in detail. The first, DOPPELAS, is designed to simulate the milder excursions in which the fuel retains its solid state. The second, SOREX 1, simulates the severe excursions which destroy the reactor explosively. Detailed examples of the input and output of the programmes are given and the way in which to utilize the input for the analysis of the various types of accidents is indicated. (auth)

32967 (EUR-3916) DIGITALIZED TRANSFER FUNCTION ANALYSER FOR PRECISION MEASUREMENTS. Bredael, I.; Garroni, A.; Sciuto, F. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 1968. 23p. Dep.

The equipment described enables one to carry out transfer function measurements in the 0.005 to 50 Hz range. The overall precision (better than 0.1%) reached in the 2 × 4 digit numerical indications (phase and quadrature) of the results is obtained by a digital conversion of the input signal (if necessary) and a completely numerical processing of the signal (multiplication by the sine and cosine reference signals, and algebraic integration during one to 100 completed perturbation cycles). The reference signals may be generated internally, or by an 8192 bit diode matrix and delivered for perturbation use in the digital form by means of a stepping motor, the velocity of which is then sinusoidally modulated, or by a digital-to-analog converter which delivers a normal sinusoidal variation signal. This signal can (after amplification) be used to drive a normal D.C. or A.C. motor. The reference signals may also be generated externally by an original photoelectric encoder delivering the sine and cosine time-modulated pulses. In this case the shaft encoder is mounted on the mechanical apparatus under testing. This equipment is particularly useful in vibration analysis. (auth)

32968 (EURFNR-478) REATTORE VELOCE PROVA ELEMENTI COMBUSTIBILI (P.E.C.) PROGETTO DI MASSIMA. (Fast Reactor Test of Fuel Elements (P.E.C.) Maximum Design). Aiello, P.; Amadesi, P.; Azzoni, P.; (and others) (Comitato Nazionale per l'Energia Nucleare, Bologna (Italy)). July 31, 1966. 66p. (In Italian). (PRV-(66)-6). Dep. CFSTI.

Work Performed under United States-Euratom Fast Reactor Exchange Program.

A general description of the PEC Fast Reactor is given. Principal criteria for the reactor design are given; the reactor and associated systems are described. All design parameters are listed; drawings show reactor building and core and pressure vessel cross sections. Neutron flux profiles of the various test facilities are shown. A core loading diagram is given; a fuel element cross section is shown. Coolant and electrical circuits are shown; schematics of nuclear instrumentation are given. (M.L.S.)

32969 (GA-8468) RESULTS OF HTGR CRITICAL EXPERIMENTS DESIGNED TO MAKE INTEGRAL CHECKS ON THE CROSS SECTIONS IN USE AT GULF GENERAL ATOMIC. Bardes, R. G.; Gillette, E. M.; Nirschl, R. J.; Traylor, R. C. (Gulf General Atomic, Inc., San Diego, Calif.). Feb. 12, 1968. Contract AT(04-3)-167. 117p. Dep. CFSTI.

Cross-section data are presented for ^{233}U, ^{235}U, ^{236}U, ^{238}U, ^{237}Np, ^{232}Th, ^{239}Pu, ^{240}Pu, and boron, the latter being used as a standard. The neutron spectra in the five critical assemblies can be characterized by their mean fission energy. This ranged from 0.074 eV in the C/U-5000 assembly to 12.7 eV in the C/U-432 assembly. The softer spectra permit the study of cross sections in the thermal energy range while the harder spectra emphasize events in the epithermal range. The comparison between the calculated and measured results for the above materials in the five core assemblies shows the percent deviation of the calculated value for a given material from the measured values. The percent deviation represents the average for the different material loadings of each material investigated and includes an allowance for the estimated experimental uncertainties. (auth)

32970 (GEAP-5584) SODIUM-COOLED REACTORS FAST CERAMIC REACTOR DEVELOPMENT PROGRAM. Twenty Fifth Quarterly Report, November 1967-January 1968. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). Mar. 1968. Contract AT(04-3)-189. 112p. Dep. CFSTI.

GENERAL ELECTRIC TEST REACTOR—operations during November 1967 to January 1968, description of; fuel element irradiation in, analysis of,
REACTOR FUEL ELEMENTS—burnup in GETR of plutonium oxide (PuO_2)-uranium oxide (UO_2), analysis of; fabrication of stainless steel-clad plutonium oxide (PuO_2)-uranium oxide (UO_2), description of; vibration stability of liquid-metal fast-breeder reactor, analysis for optimum, (E/T)
PLUTONIUM OXIDES PuO_2—PuO_2-UO_2, burnup of type 316 stainless steel-clad, gamma scan analysis of; transient radiation effects on, neutron radiography analysis of; transient radiation effects on, temperature distribution from; melting point of, radiation effects on
STAINLESS STEEL—performance of cladding of type 316, gamma scan analysis of plutonium oxide (PuO_2)-uranium oxide (UO_2) fuel burnup; radiation effects on tensile properties of type 304, type 316 L, and type 347, measurement at 1300°F of fast neutron
GAMMA SPECTROSCOPY—use for burnup analysis of type 316 stainless steel-clad plutonium oxide (PuO_2)-uranium oxide (UO_2) fuel elements
RADIOGRAPHY, INDUSTRIAL—use for determining transient radiation effects on plutonium oxide (PuO_2)-uranium oxide (UO_2) axial restrained fuel elements
ELECTRON MICROSCOPY—use for radiation effects on stainless steel-clad plutonium oxide (PuO_2)-uranium oxide (UO_2) fuel elements
NEUTRONS, FAST—effects on mechanical properties of stainless steel-clad plutonium oxide (PuO_2)-uranium oxide (UO_2); effects on tensile properties of type 304, type 316L, type 347, stainless steels and Incoloy 800 at 1300°F, measurement of
URANIUM-238—capture cross section of, error analysis for
PLUTONIUM-239—capture cross section of, error analysis for; fission cross section of, error analysis for
FAST CERAMIC REACTOR—power distribution in, computer programs for calculation of
REACTORS, BREEDER—fuel elements for liquid-metal fast-analysis for optimum vibration stability in, (E/T)
INCOLOY 800—radiation effects on tensile properties of, measurement at 1300°F of fast neutron (D.L.C.)

32971 (IAN-R-1-2) DETERMINACION DE ALGUNOS PARAMETROS EN EL REACTOR NUCLEAR IAN-R1. (Determination of Several Parameters in the Nuclear Reactor IAN-R1). Sandoval, Edmundo; Ramirez, Gustavo; Barragan, Antonio; Casabianca, Manuel (Instituto de Asuntos Nucleares, Bogota (Columbia). Division Reactor). [1967]. 91p. (In Spanish). Dep.

A description of the IAN-R1 research reactor is given. Neutron flux measurements are discussed; flux profiles are given for several core positions; calculational procedures are described. Reactivity measurements for the reflector, core, and experimental facilities are discussed. Reactor sensitivity to reactivity coefficients is determined. Measurement of the temperature coefficient of reactivity is detailed. (M.L.S.)

32972 (IN-1139) REACTIVITY EFFECTS OF LOW NEUTRON ABSORBER SAMPLES IN THE ADVANCED REACTIVITY MEASUREMENT FACILITIES. Wilson, A. E.; Fast, E.; Rogers, J. W.; Millsap, D. A. (Idaho Nuclear Corp., Idaho Falls). May 1968. Contract AT(10-1)-1230. 46p. Dep. CFSTI.

The absorption statistical weights in the Advanced Reactivity Measurement Facilities are shown to be dependent upon the slowing down power of the sample medium containing the absorber. Measurements were made for light and heavy water solutions of boric acid and ^{3}He in the range of 0.0 to 2.0 cm^2 of total sample absorption cross section with 46 ml cylindrical samples. The observed increase in absorption statistical weight with slowing down power of the sample is attributed to the coupling between the neutron scattering and absorption. A simple mathematical model is presented that accounts qualitatively for the results. Reactor calculations are in general agreement with experimental observations. Some data are also given of samples in which the absorption was maintained constant while the slowing down power was changed, and of samples of reduced density. Further measurements are suggested to improve the interpretation of these results. (auth)

32973 (IN-1160) IRRADIATION TESTING OF FUEL FOR THE MARK I CORE OF THE ARGONNE ADVANCED RESEARCH REACTOR. Graber, M. J.; Gibson, G. W. (Idaho Nuclear Corp., Idaho Falls.). Apr. 1968. Contract AT(10-1)-1230. 62p. Dep. CFSTI.

The irradiation testing and evaluation of a 37 wt % low-density UO_2 stainless steel dispersion fuel is reported. This fuel was originally proposed for the long fuel cycle operation of the Argonne Advanced Research Reactor. The results show that starting density of the fuel can affect the operating life. (auth)

32974 (IN-1186) ATR PRIMARY COOLANT SYSTEM CHECK VALVE PROBLEM ANALYSIS AND CORRECTION. Bridges, T. L.; Burr, T. K. (Idaho Nuclear Corp., Idaho Falls). May 1968. Contract AT(10-1)-1230. 80p. Dep. CFSTI.

During the final stage of equipment and system testing and prior to initial operation of the Advanced Test Reactor, several deficiencies were discovered in the primary coolant system check valves. Each of these deficiencies, uncovered at different times, affected the safety and reliability of reactor operation and, consequently, required correction before startup of the reactor. Several Engineering and Operations groups were involved in contributing to a satisfactory solution in the shortest time. During the analysis, modification, and testing phase of the work, periodic status reports were submitted to the Idaho Operations Office of the USAEC. Some of the previously written material is utilized to provide a complete documentation of events leading to the discovery of the check valve deficiencies, the resulting investigations, the solutions, and the tests conducted to verify the solutions. Recommendations also are included which should be considered in the future preparation of specifications for check valves. (auth)

32975 (LA-3883) CRITICAL DIMENSIONS OF HOMOGENEOUS SPHERES CONTAINING ^{235}U, ^{238}U, AND CARBON FOR VARIOUS C/ ^{235}U RATIOS AND ^{235}U ENRICHMENTS. Engle, L. B.; Stratton, W. R. (Los Alamos Scientific Lab., N. Mex.). Dec. 15, 1967. Contract W-7405-eng-36. 13p. Dep. CFSTI.

The critical dimensions of homogeneous spheres containing ^{235}U, ^{238}U, and carbon at various C/^{235}U moderating ratios and ^{235}U enrichments are presented. Some values of k_∞ for these mixtures are included. (auth)

32976 (MIT-2344-12) HEAVY WATER LATTICE PROJECT FINAL REPORT. Thompson, T. J.; Kaplan, I.; Driscoll, M. J. (eds.) (Massachusetts Inst. of Tech., Cambridge. Dept. of Nuclear Engineering). Sept. 30, 1967. Contract AT(30-1)-2344. 208p. (MITNE-86). Dep. CFSTI.

CRITICALITY STUDIES—physics of heavy water-moderated slightly enriched uranium-fueled lattices, (E/T)
NEUTRONS—buckling in heavy water-moderated uranium oxide (UO_2)-fueled lattices, (E/T); multiplication constant measurements in heavy water-moderated uranium oxide (UO_2)-fueled lattices, (E/T)
REACTIVITY—measurement in heavy water-moderated uranium oxide (UO_2)-fueled lattices, (E/T); coolant void effects on, in heavy water-moderated uranium oxide (UO_2)-fueled lattices, (E/T)
URANIUM-238—neutron resonance integrals for, determination of effective, (E/T); neutron fission ratio to uranium-235, measurement by γ spectrometry
REACTOR FUEL ELEMENTS—neutron temperature measurements in, method for integral, (E/T); physics measurements on single, pulsed neutron method for, (E/T); physics parameter measurements in uranium oxide (UO_2), comparison of metal and oxide foils for, (E)
REACTORS, HETEROGENEOUS—lattice characteristics analysis in, unit cell simulation for, (T); fuel rod characterization parameter determination in, (E/T); lattice parameter analysis in, determination of fuel rod interaction kernels for, (E/T)
URANIUM-235—neutron fission ratio to uranium-238, measurement by γ spectrometry
WATER-d_2—analysis for water concentration, accuracy of infrared detector for
INFRARED ANALYZERS—accuracy for monitoring heavy water purity
RADIATION DETECTORS, CHERENKOV—performance in reactor noise analysis system
URANIUM, URANIUM OXIDES UO_2—use in physics parameter measurements in uranium oxide (UO_2) fuel rods, comparison of metal and oxide foils for (H.D.R.)

32977 (NAA-SR-Memo-12289) THE CONTRIBUTION OF THERMAL EXPANSION TO THE TEMPERATURE COEFFICIENT OF REACTIVITY OF ^{235}U METAL SAMPLES. Mountford, L. A.; Springer, T. H.; Carpenter, S. G.; Tuttle, R. J. (Atomics International, Canoga Park, Calif.). Mar. 27, 1967. 23p. (CONF-650602-89). Dep. CFSTI.

From American Nuclear Society 11th Annual Meeting, Gatlinburg, Tenn.

The reactivity effect of thermal expansion of ^{235}U metal has been measured and calculated in a series of neutron energy spectra. The correction of the measured temperature coefficient of reactivity for this effect to obtain the Doppler effect is shown for one of these spectra. The results of temperature coefficient measurements with ^{238}U and Th in these spectra are given. (auth)

32978 (ORNL-TM-2232) OPERATING SAFETY LIMITS FOR THE POOL CRITICAL ASSEMBLY (PCA). Costner, R. A. Jr. (Oak Ridge National Lab., Tenn.). May 15, 1968. Contract W-7405-eng-26. 9p. Dep. CFSTI.

Operating limits for the PCA determined by design or experience are listed for each operating variable which has direct reactor safety significance. Included are limitations placed on experiments and those placed on administration of the operation. (H.D.R.)

32979 EVALUATION OF U-10 PERCENT Mo ALLOY AND CONSIDERATION OF AN ALTERNATE ALLOY FOR PULSE REACTOR CORES. Litman, A. P.; Leonard, W. J.; Lundin, M. I. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 154-5(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32980 MECHANICAL BEHAVIOR OF TYPE-304 STAINLESS STEEL IN COPPER-CONTAMINATED SODIUM IN THE RANGE 950 TO 1100°F. Atkins, D. F. (Atomics International, Canoga Park, Calif.). Trans. Amer. Nucl. Soc., 11: 141-2(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32981 ELEMENTARY SYNTHETIC APPROACH TO THREE-DIMENSIONAL TRANSPORT PERTURBATION THEORY. Sargis, D. A.; Cohen, S. C. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc., 11: 173-4(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32982 ADJOINT BIASING IN MONTE CARLO CRITICALITY CALCULATIONS. Whitesides, G. E. (Union Carbide Corp., Oak Ridge, Tenn.). Trans. Amer. Nucl. Soc., 11: 159(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32983 FAST-NEUTRON DOSE RATE MEASUREMENTS AT THE WRIGHT PATTERSON AIR FORCE BASE NUCLEAR ENGINEERING CENTER. Dooley, John A. (Wright Patterson AFB, Ohio); Fasano, Anthony N.; Whittenberger, William W. Trans. Amer. Nucl. Soc., 11: 198(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32984 TRANSIENT IRRADIATION EXPERIMENTS WITH VIBRATIONALLY COMPACTED UO_2 FUEL RODS IN TREAT. Gulley, R. L. (Battelle Memorial Inst., Richland, Wash.); Armstrong, D. R.; Harrison, L. J. Trans. Amer. Nucl. Soc., 11: 111-12(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32985 IN-REACTOR SINTERED FUEL. Horn, Glen R.; Gulley, R. L. (Battelle Memorial Inst., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 112(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32986 ADVANCES IN THE FTR FUEL SUBASSEMBLY DESIGN. Cohn, P. D.; Bennett, T. J.; Jackson, R. J.; Kolesar, D. C.; Lobsinger, R. J.; Millhollen, M. K. (Battelle Memorial Inst., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 102-3 (June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32987 DESIGN BASES FOR FAST TEST REACTOR DRIVER FUEL PIN. Hanson, J. E.; Cohn, P. D.; Jackson, R. J. (Battelle Memorial Inst., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 103-4(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32988 IRRADIATION OF ZIRCALOY-2-CLAD FUEL RODS CONTAINING DISHED PELLET UO_2 FUEL. Rowland, T. C. (General Electric Co., San Jose, Calif.). Trans. Amer. Nucl. Soc., 11: 106(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32989 MONTE CARLO CALCULATION OF RESONANCE ESCAPE PROBABILITY IN URANIUM AND URANIUM OXIDE LATTICES. Troubetzkoy, E. S.; Schmuckler, Y. (United Nuclear Corp., Elmsford, N. Y.). Trans. Amer. Nucl. Soc., 11: 163 (June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-6806001.

32990 NEW APPROACH FOR DETERMINING THE REACTIVITY OF A SUBCRITICAL SYSTEM. Ram, K. S. (Univ. of Cincinnati). Trans. Amer. Nucl. Soc., 11: 191-2(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32991 COMPARISON OF AGE MEASUREMENTS AND AGE CALCULATIONS USING HYPOTHETICAL EIGENVALUE BIAS. Candelore, N. R.; Gast, R. C. (Bettis Atomic Power Lab., West Mifflin, Pa.). Trans. Amer. Nucl. Soc., 11: 163-4(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32992 ENERGY SPECTRA AND THE DISPERSION LAW OF NEUTRON WAVES IN FAST MULTIPLYING MEDIA. Travelli, A. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 189-90(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32993 DETERMINATION OF THE DISPERSION LAW IN A D_2O–UC SYSTEM. Parkinson, T. F. (Univ. of Missouri, Columbia); Olarte, F. J. Trans. Amer. Nucl. Soc., 11: 190 (June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32994 REACTOR NEUTRON PULSE PROPAGATION IN MULTIPLYING MEDIA. Doshi, P. K.; Miley, G. H. (Univ. of Illinois, Urbana). Trans. Amer. Nucl. Soc., 11: 191(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32995 PHENOMENOLOGY OF NEUTRON WAVE AND PULSE PROPAGATION. Moore, M. N. (San Fernando Valley State Coll., Northridge, Calif.). Trans. Amer. Nucl. Soc., 11: 41(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32996 EXPERIMENTAL ASPECTS OF NEUTRON WAVE AND PULSE PROPAGATION. Perez, R. B. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 41-3(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32997 EXPERIMENTAL COMPARISON OF FAST- AND THERMAL-NEUTRON BUCKLINGS IN A CRITICAL ASSEMBLY. Shaw, Robert A. (Clarkson Coll. of Tech., Potsdam, N. Y.); Clark, David D. Trans. Amer. Nucl. Soc., 11: 48-9(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32998 LOW-POWER NUCLEAR REACTOR BASED ON MINIMUM CRITICAL MASS. Brasier, Robert I. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc., 11: 15(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

32999 EXPERIMENTAL MEASUREMENT OF K_∞ AND η IN SUBCRITICAL LATTICES. Harrington, J.; Lanning, D. D.; Thompson, T. J.; Kaplan, I. (Massachusetts Inst. of Tech., Cambridge). Trans. Amer. Nucl. Soc., 11: 48(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33000 PATTERN IN MONTE CARLO CALCULATIONS OF CRITICAL EXPERIMENTS. Conley, G. H. (Bettis Atomic Power Lab., West Mifflin, Pa.). Trans. Amer. Nucl. Soc., 11: 160-1 (June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33001 IRRADIATION OF METALLIC–URANIUM HOLLOW-CORE FUEL ELEMENTS TO 1 AT. PERCENT BURNUP. Leggett, R. D.; Marshall, R. K.; Weber, J. W. (Battelle Memorial Inst., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 153-4 (June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33002 PRESSURIZED FACILITY FOR HIGH-TEMPERATURE SUBCRITICAL EXPERIMENTS. Carver, J. G. (North American Rockwell Corp., Downey, Calif.). Trans. Amer. Nucl. Soc., 11: 283(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33003 IDENTIFICATION OF FAILED FUEL ELEMENTS IN MULTICHANNEL IRRADIATION RIGS. French, R. L. D. (United Kingdom Atomic Energy Authority, Windscale, Eng.). J. Nucl. Energy, 22: 325-7(May 1968).

From theoretical considerations it is shown that gross β- or γ-monitors are in general inadequate for the identification of channels containing failed elements in multichannel rigs. A simplified expression $[F = (G/g) \Lambda + 1]$ is derived, where F is the ratio of the activity of a failed channel to a clean channel, G is the total mass of coolant, g is the channel coolant flow, and Λ is the fission product loss-constant. Each parameter is examined with a view to improving discrimination between channels. (UK)

33004 PROMPT NEUTRON DECAY AND REACTIVITY MEASUREMENTS IN SUBCRITICAL URANIUM METAL CYLINDERS. Mihalczo, J. T. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. Nucl. Sci. Eng., 32: 292-301(1968). (ORNL-P-3620).

Prompt-neutron decay constants have been determined for unreflected and unmoderated subcritical cylinders of enriched uranium (93.15 wt % ^{235}U) by the Rossi-α technique. The cylinder diameters were 17.77, 27.93, and 38.09 cm and the heights varied from 10.184 to 2.548, 8.431 to 5.399, and 7.502 to 4.780 cm, respectively. The decay constants agreed to within 4% with those measured by the pulsed-neutron method; the comparison with the results of S_n transport theory calculations showed disagreements as large as 20%. The ratio of the prompt-neutron decay constant of a cylinder at delayed criticality to that of a subcritical cylinder and the ratio of the corresponding prompt-neutron lifetimes were used to obtain subcritical reactivities as great as 33 dollars. The lifetimes were calculated using neutron fluxes from S_8 transport theory. These reactivities agreed favorably with values determined by an analog computer whose input was the response of an ionization chamber to power changes when an assembly was disassembled from delayed criticality to a given reactivity. 11 references. (auth)

33005 MONTE CARLO CRITICALITY CALCULATIONS FOR THERMAL REACTORS. Mendelson, M. R. (Knolls Atomic Power Lab., Schenectady, N. Y.). Contract W-31-109-Eng-52. Nucl. Sci. Eng., 32: 319-31(1968). (KAPL-P-3374).

The feasibility of using Monte Carlo methods to compute the criticality of thermal reactors is investigated by analyzing three simple critical assemblies with the 05R Monte Carlo neutron transport code. Results indicate that a precision of 0.5 to 0.8% in the eigenvalue is obtainable for these cores in less than one hour on the CDC-6600 computer. Further time reductions are foreseeable pending refinements in the operating system and more effective utilization of variance-reduction techniques. Several aspects of problem strategy and variance estimation are examined, leading to increased understanding of criticality estimators and correlation of data. 29 references. (auth)

33006 REACTOR PHYSICS PARAMETERS OF 1.03 PERCENT ENRICHED URANIUM METAL, D_2O MODERATED LATTICES. D'Ardenne, Walter H. (Pennsylvania State Univ., University Park); Bliss, Henry E.; Lanning, David D.; Kaplan, Irving; Thompson, Theos J. Nucl. Sci. Eng., 32: 283-91(1968).

Reactor physics parameters were measured in three heavy water lattices consisting of 0.250-in.-diam, 1.03 wt % ^{235}U metal fuel rods in triangular arrays spaced at 1.25, 1.75, and 2.50 in. The following quantities were measured in each lattice: the ratio of epicadmium to subcadmium radiative captures in ^{238}U; the ratio of epicadmium to subcadmium fissions in ^{235}U; the ratio of radiative captures in ^{238}U to fissions in ^{235}U; and the fissions in ^{238}U to fissions in ^{235}U. These experimental results were used to calculate the following reactor physics parameters for each lattice: the resonance escape probability, the fast fission factor, the multiplication factor for an infinite system and the initial conversion ratio. Analytical results obtained by using THERMOS and GAM-I are in fair agreement with the experimental results. 11 references. (auth)

33007 EXCESS REACTIVITY MEASUREMENTS: A DIFFERENT APPROACH. Jefferson, Robert M. (Sandia Corp., Albuquerque, N. Mex.). Trans. Amer. Nucl. Soc., 11: 285-6(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33008 MEASURED PERFORMANCE OF THE ANNULAR CORE PULSE REACTOR. Hasenkamp, F. A. (Sandia Corp., Albuquerque, N. Mex.). Trans. Amer. Nucl. Soc., 11: 284-5 (June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33009 THE EFFECT OF RESONANCE OVERLAP ON ^{238}U CAPTURE IN REACTOR LATTICES. Hellens, R. L.; Mizuta, H. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc., 11: 256-7(June 1968).

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33010 DIFFUSION-LENGTH EXPERIMENTS IN THE CONTINUOUS EIGENVALUE REGION. Palmedo, P. F.; Conant, J. F. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc., 11: 255-6(June 1968).

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33011 A PRIMER ON PULSED-NEUTRON MEASUREMENTS IN MULTIPLYING MEDIA. Garelis, Edward (Univ. of California, Livermore). Trans. Amer. Nucl. Soc., 11: 40-1(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33012 RESONANCE ABSORPTION IN MULTIPLATE REACTOR CELLS BY INTEGRAL TRANSPORT THEORY. Olson, Arne P. (Argonne National Lab., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc., 11: 301-2(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33013 EVALUATION OF HOMOGENEOUS AND HETEROGENEOUS METHODS OF ANALYSIS IN A SUBCRITICAL ASSEMBLY. Haroon, M. R. (Georgia Inst. of Tech., Atlanta); Grant, P. J. Trans. Amer. Nucl. Soc., 11: 303(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33014 LIMITATIONS ON THE PULSED-NEUTRON TECHNIQUE OF MEASURING SUBCRITICAL PARAMETERS. Flournoy, W. G. (Westinghouse Astronuclear Lab., Pittsburgh). Trans. Amer. Nucl. Soc., 11: 294-5(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33015 TIME DECAY CONSTANTS IN PULSED MULTIPLYING MEDIA. Rodriguez, Pablo J.; Nguyen, Dong H. (Univ. of Texas, Austin). Trans. Amer. Nucl. Soc., 11: 289-90(June 1968).

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33016 THE HIGH-ENERGY INELASTIC SCATTERING AND THE EARLY NEUTRON DECAY IN ^{238}U ASSEMBLIES. Gozani, Tsahi; d'Oultremont, P. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc., 11: 292-3(June 1968).

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33017 THERMAL ANALYSIS OF THE FORCED COOLING SYSTEM OF THE ILLINOIS ADVANCED TRIGA REACTOR. Jones, B. G.; Schilmoeller, N. H.; Hang, D. F.; Beck, G. P. (Univ. of Illinois, Urbana). Trans. Amer. Nucl. Soc., 11: 268-9(June 1968).

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33018 EXPERIENCE TO DATE WITH THE BERKELEY MARK-III TRIGA RESEARCH REACTOR. Ruby, Lawrence (Univ. of California, Berkeley). Trans. Amer. Nucl. Soc., 11: 268(June 1968).

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33025 UTILIZATION OF THE TRIGA REACTOR OF THE INSTITUTO DE PESQUISAS RADIOATIVAS DA U.F.M.G., BRAZIL, DURING SEVEN YEARS OF OPERATION. Lima, J. M.; Andrade, V. M. (Univ. Federal de Minas Gerais, Belo Horizonte, Brazil). Trans. Amer. Nucl. Soc., 11: 270-1(June 1968).

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33026 BUCKLING AND PARAMETER MEASUREMENTS IN THE Th–D_2O ORGANIC SYSTEM. Pellarin, D. J.; Baumann, N. P.; Satterfield, R. M.; Vandervelde, V. D. (E. I. duPont de Nemours and Co., Aiken, S. C.). Trans. Amer. Nucl. Soc., 11: 253-4(June 1968).

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33027 MEASUREMENTS ON LATTICES OF UO_2–PuO_2 ROD CLUSTERS IN D_2O WITH D_2O, AIR, AND ORGANIC COOLANTS. Baumann, N. P.; Pellarin, D. J.; Olson, R. L.; O'Neill, G. F. (E. I. duPont de Nemours and Co., Aiken, S. C.). Trans. Amer. Nucl. Soc., 11: 254-5(June 1968).

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33028 FLOW AND HEAT TRANSFER EXPERIMENTS OF FUEL AND CONTROL ELEMENTS FOR JAPAN MATERIALS TESTING REACTOR CORE. Morita, Takahiro; Uchigasaki, Giichiro (Hitachi, Ltd., Japan). Hitachi Hyoron, 49: No. 9, 12-16(Sept. 1967). (In Japanese).

A limitation design is required in the thermal and hydraulic design of the JPDR core due to the high neutron flux and high power density of the reactor core. To increase the heat removal, the thin fuel plates must be cooled by high-velocity cooling water. This presents problems connected with flow distribution in the fuel elements, pressure drop, vibration of the fuel plates, burn-out, and heat transfer to the cooling water. Prior to the detailed design of the reactor core, experiments were made on these problems, using dummy elements and imitated specimens. It was shown that the fuel and the control elements proposed for the JMTR could sufficiently satisfy the conditions of high temperature load during the JMTR operation. The results of the experiments and their application to the reactor-core design are described. (NSA of Japan)

33029 CURIUM DECONTAMINATION OF WATER-COOLED REACTOR. Scott, R. L. Nucl. Safety, 9: 322-3(July-Aug. 1968).

Curium contamination of primary coolant systems occurred in 1967 at ORNL's High Flux Isotope Reactor and at Belgium's BR-2. Most of the curium plated out on the system walls and was thus removed as a problem; the remainder was suspended in the coolant as an insoluble oxide, however, and could not be removed by normal ion exchange. It was found that the addition of lanthanum to the cooling water changed the state of the suspended curium so that it could be completely removed by demineralizers. 6 references. (auth)

33030 REACTIVITY ACCIDENT INVESTIGATIONS WITH A PRESSURIZED-WATER REACTOR CORE IN THE SPERT-III FACILITY. Houghtaling, J. E.; McCardell, R. K.; Herborn, D. I. (Phillips Petroleum Co., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc., 11: 368-9(June 1968).

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33031 FAST-NEUTRON SPECTRUM MEASUREMENTS IN THE CORE AND REFLECTOR OF ZPR-3 ASSEMBLY-51. Powell, J. E. (Argonne National Lab., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc., 11: 217-18(June 1968).

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33033 PULSE CHARACTERISTICS OF SANDIA PULSED REACTOR-II. Coats, R. L.; O'Brien, P. D. (Sandia Corp., Albuquerque, N. Mex.). Trans. Amer. Nucl. Soc., 11: 219-20 (June 1968).

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33035 A "BENCHMARK" SERIES OF PLUTONIUM-FUELED FAST CRITICAL ASSEMBLIES. Davey, W. G. (Argonne National Lab., Idaho Falls, Idaho); Broomfield, A. M.; Amundson, P. I.; (and others). Trans. Amer. Nucl. Soc., 11: 239-40(June 1968).

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From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33037 DOPPLER EFFECT MEASUREMENTS AND ANALYSIS IN ZPR-3 ASSEMBLY-50. Gasidlo, J. M.; Nicholson, R. B. (Argonne National Lab., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc., 11: 240-1(June 1968).

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33038 VARIATIONS IN THE FAST-SPECTRUM DOPPLER COEFFICIENTS OF Th AND ^{238}U AS A FUNCTION OF THE TYPE AND TEMPERATURE OF THE ENVIRONMENT. Springer, T. H.; Tuttle, R. J. (Atomics International, Canoga Park, Calif.). Trans. Amer. Nucl. Soc., 11: 241-2(June 1968).

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33043 IMPORTANCE OF THE WEIGHTING SPECTRUM IN REACTIVITY CALCULATIONS. Madell, J. T. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 246-7(June 1968).

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33044 CHANGE IN REACTIVITY DUE TO WATER LOSS IN GRAPHITE-MODERATED SUPERCELLS. Newman, D. F.; Vaughn, A. D. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 248-9(June 1968).

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33046 EXPERIMENTAL BUCKLINGS OF SIMULATED BURNED-UP NATURAL URANIUM CLUSTERS IN HEAVY WATER MODERATOR. French, P. M.; Solheim, R. (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Trans. Amer. Nucl. Soc., 11: 251-2(June 1968).

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33052 A MULTIGROUP ANALYSIS OF THE CRITICALITIES OF THE ZPR-3 PLUTONIUM-FUELED ASSEMBLIES 48, 48B, 49, AND 50. Broomfield, A. M. (Atomic Energy Establishment, Winfrith, Eng.); Palmer, R. G. Trans. Amer. Nucl. Soc., 11: 203-4(June 1968).

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From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33078 STABILITY OF A FAST REACTOR WITH IN-CORE THERMIONIC CONVERTERS. Hetrick, David L.; Schmidt, Theodore R. (Univ. of Arizona, Tucson). Trans. Amer. Nucl. Soc., 11: 221-2(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33079 IMPROVEMENTS IN THE REPRESENTATION OF PLUTONIUM REACTION RATES. Eich, W. J. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc., 11: 304-5(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33080 ANALYSIS OF A SET OF HOMOGENEOUS U–H$_2$O SPHERES. Staub, Alan; Harris, D. R.; Goldsmith, M. (Westinghouse Electric Corp., West Mifflin, Pa.). Trans. Amer. Nucl. Soc., 11: 305-6(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33081 CALCULATED PHOTONEUTRON YIELD EFFICIENCIES FOR HETEROGENEOUS ASSEMBLIES CONTAINING D$_2$O. Woodruff, Gene L. (Univ. of Washington, Seattle). Trans. Amer. Nucl. Soc., 11: 307(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33082 CALORIMETRIC RADIATION HEATING RATE MEASUREMENTS IN A CRITICAL ASSEMBLY AND COMPARISON TO DIFFUSION THEORY CALCULATIONS. Mikoleit, L. A.; Braun, J. C.; Beyer, R. F.; Ryan, T. M.; Valentine, R. F. (Bettis Atomic Power Lab., West Mifflin, Pa.). Trans. Amer. Nucl. Soc., 11: 420(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

Production Reactors

Refer also to abstracts 31335 and 32956.

33083 (DUN-SA-67) HANFORD REACTORS. Batishko, C. R. (Douglas United Nuclear, Inc., Richland, Wash.). May 6, 1968. Contract AT(45-1)-1857. 45p. Dep. CFSTI.

The facilities and physical layout of the Hanford Plant are described. Out of a total of 9 Pu production reactors on the area, 4 are active. The physical features, fuel cycle, and physics of the reactors are discussed, and unique features of the dual-purpose power-Pu production N Reactor are described. (H.D.R.)

Reactor Theory, Components, Fuels and Accessories

Refer also to abstracts 30669, 30798–30805, 30808, 30809, 30833, 30837–30839, 30875, 30899, 30904–30906, 31347, 31467, 31468, 31474, 31480, 31490, 31527, 32421, 32425, 32426, 32428, 32456, 32457, and 32930.

33084 (AECL-2788) REVIEW OF FLUIDIZATION RELEVANT TO A LIQUID FLUIDIZED BED NUCLEAR REACTOR. Trupp, A. C. (Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment). Oct. 1967. 131p. Dep. CFSTI. CAN $2.50.

The dynamics and heat transfer associated with isolated spheres, packed beds and liquid fluidized beds are reviewed. Topics on fluidization dynamics include gas versus liquid fluidization, minimum fluidizing velocity, bed expansion, solids motion and density distributions and fluctuations. The survey concludes with a summary of the technology needed to design a Liquid Fluidized Bed Reactor. The adequacy of the available data is assessed. The field of liquid fluidization was found to be particularly weak in several dynamic areas and in fluidized particle-to-liquid heat transfer. The report is intended mainly as a guide for experimental and analytical studies into areas requiring further exploration in order for the fluidized bed reactor concept to be adequately evaluated. In keeping with this purpose, many of the basic relations involved are developed and the equations are presented for handy reference. (auth)

33085 (AAEC/TM-449) BIBLIOGRAPHY ON THE BURN-UP OF NUCLEAR FUELS. Palmer, A. R.; Whittem, R. N. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Mar. 1968. 43p. Dep.

Information of a general nature on burnup determination, including surveys and reviews of the literature, is given. References to destructive and non-destructive methods of burnup determination are tabulated. Methods of calculation are listed with the exception of named burnup codes which are separately listed. Some references to the effects of burnup on reactivity are included. The references are taken from Nuclear Science Abstracts (up to January 1968) and the A.A.E.C. report library. (auth)

33086 (ANL-7310, pp 431-511) REACTOR COMPUTATION METHODS AND THEORY. (Argonne National Lab., Ill.).

COMPUTER PROGRAMS—ARC system, for reactor physics and design calculations; MC^2, description of; ITER 7, for finding minima, directed search subroutine in Fortran

REACTORS—design and physics calculations for, description of ARC program system for; neutron flux spectra in, effects of resonance-scattering interfaces on; power of, effects of collapsed group cross sections on calculations of; neutron diffusion equation for reflected, two-group space-dependent; neutron transport equations for, error bounds for eigenvalue approximations for

NEUTRON CROSS SECTIONS—generation of multigroup, description of MC^2-THERMOS code for; generation for fast reactors of thermal, use of MC^2-THERMOS code for; data for, description of Fortran codes for processing; generation of bilinearly-weighted absorption, description of ADRIFT code for; calculated S-wave plutonium-239 fission; calculated S-wave uranium-235 fission; calculated S-wave uranium-238 fission; crystalline effects on Doppler-broadened uranium

EXPERIMENTAL BOILING WATER REACTOR—physics parameters for, MC^2-THERMOS calculations of

CRITICAL ASSEMBLIES—lattice parameters for High Conversion Lattice, MC^2-THERMOS calculations of; neutron decay constants in ZPR-9, comparison of calculated and measured prompt; core materials for ZPR-9, two-group macroscopic cross sections for

REACTORS, FAST—neutron cross sections for, MC^2-THERMOS generation of thermal; resonance absorption in, description of RABBLE and RABZPR codes for calculating; Doppler coefficients for, effects of unresolved resonance parameters on; neutron fluxes for, effects of unresolved resonance parameters on adjoint; physics analyses of, effects of multigroup cross section requirement on; reactivity effect calculations for, effects of neutron cross section refinement on; neutron spectra for, effects of cross section errors on; kinetics model for, description of modified adiabatic spatial; kinetics of coupled thermal-, description of model for space-dependent; sodium coolant removal from, effects on flux and asymptotic power shape of; fuel cycle studies for

PLUTONIUM ISOTOPES Pu-239—resonance parameters for

URANIUM ISOTOPES U-235—resonance parameters for

URANIUM ISOTOPES U-238—resonance parameters for

SODIUM—neutron elastic removal cross sections for, multigroup refinement of

REACTOR SAFETY—kinetics equations for, description of MOVER program for solution to one-group space independent excursion

NEUTRONS—dispersion law for, multigroup transport approximations for

GRAPHITE—neutron relaxation length in, multigroup transport approximation for complex inverse

TRANSPORT THEORY—equations for, orthogonal polynomial solutions and error estimates for eigenvalues to integral

CRITICALITY STUDIES—mass calculations for slabs of various half thicknesses, use of Legendre polynomial trial functions for

REACTORS, THERMAL—resonance absorption in, description of RABBLE and RABZPR codes for calculating; kinetics of coupled fast-, description of model for space-dependent

URANIUM—neutron cross sections for, crystalline effects on Doppler-broadened; resonance integrals for, crystalline effects on (M.L.S.)

33087 (ANL-7310, pp 513-22) MISCELLANEOUS. (Argonne National Lab., Ill.).

LASERS—performance of nuclear pumped carbon dioxide gas

THERMIONIC CELLS—plasma oscillations in low pressure alkali metal vapor, analysis of

PLASMA—ion frequency in, use of low pressure alkali metal vapor thermionic cells for analysis of

RARE GASES—electrical conduction through, measurement of high temperature

HELIUM—electrical conduction through, measurement of high temperature
ARGON—electrical conduction through, measurement of high temperature
CARBON—production by cosmic rays, measurement of radioactive
NEUTRONS—spectra of fast cosmic ray, measurement of energy (M.L.S.)

33088 (EIR-132) ZUR BERECHNUNG VON HETEROGENEN RESONANZINTEGRALEN UNTER BERUECKSICHTIGUNG EINES NICHTASYMPTOTISCHEN MODERATORFLUSSES UND EINER NICHTUNIFORMEN TEMPERATURVERTEILUNG IM SPALTSTOFF. (Calculation of Heterogeneous Resonance Integrals Allowing for a Nonasymptotic Moderator Flux and a Nonuniform Temperature Distribution in Fissionable Fuel). Tschirky, H. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). Mar. 1968. 72p. (In German). Dep.

The multigroup transport equations for determination of heterogeneous resonance integrals are formulated in cylindrical geometry in terms of lethargy. The formulation allows for nonasymptotic moderator fluxes and a nonuniform fission product temperature distribution. Lie series methods are used for flux expansions in the multigroup formulation. Applications of the formulation are discussed; a sample problem is solved. A formulation of the Doppler broadened resonance cross section is formulated according to Breit-Wigner techniques; the NR- and WR-approximations, solutions to the integral and integro-differential transport equations. Monte Carlo methods and equivalence theory are considered as possible methods for solution to the integral equations arising in the cross section calculations. 64 references. (M.L.S.)

33089 (EURFNR-461) MUNDO: A DIGITAL CODE FOR COMPUTING ACCIDENT DOSE RATES IN REACTOR ENVIRONS. Heller, F.; Schikarski, W.; Wickenhaeuser, A. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). Translated from report KFK-653. 33p. (EUR-3684). Dep. CFSTI.

Work Performed under United States-Euratom Fast Reactor Exchange Program.

The description of the MUNDO computer code is presented. The code calculates the dose equivalent received at the point F and time t in (rem), as a function of prescribed parameters. The calculations refer to accident conditions in a reactor environment. (D.C.C.)

33090 (KAPL-M-6725) APPLICATION OF DYNAMIC PROGRAMMING TO THE OPTIMAL CONTROL OF XENON-POWER SPATIAL TRANSIENTS. Stacey, Weston M. Jr. (Knolls Atomic Power Lab., Schenectady, N. Y.). July 31, 1967. Contract W-31-109-eng-52. 20p. Dep. CFSTI.

Dynamic programming is applied to obtain a computing algorithm for the optimal control of xenon-power spatial transients in a nuclear reactor. In order to limit the number of possible states in the flux-xenon-iodine-temperature-control phase space which must be considered, the time interval is divided into a few decision intervals, and the possible states are computed by a branching type calculation. A FORTRAN program is described which solves the optimal control problem for xenon-power transients in three spatial dimensions, with thermal feedback. The techniques are demonstrated for a shutdown transient on a realistic reactor model. (auth)

33091 (KAPL-M-6738) CAINE LIBRARY 51. Phillips, Carol L.; Seidel, Robert L. (Knolls Atomic Power Lab., Schenectady, N. Y.). Oct. 1967. Contract W-31-109-eng-52. 49p. Dep. CFSTI.

A new three-group cross section library (CAINE Library 51) has been developed for use on small, high-leakage cores. The library was developed in order to reduce the large reactivity bias which has been observed between small critical experiments and their calculations. The new library consists of epithermal β^γ fits of FOMENT fast and epithermal cross sections and a thermal cross section treatment based on the Goldman Improved Nelkin water kernel. The fast and epithermal group constants are based on a fuel region critical buckling of 0.01 cm^{-2}. Separate fits exist for fuel regions and for untied structure regions. The library is applicable to high leakage cores containing basically 93% enriched uranium, ^{10}B, Zircaloy and water. (auth)

33092 (KFK-700(Pt. I)) DIE BRENNELEMENTENTWICKLUNG ALS PHYSIKALISCH-TECHNISCHE AUFGABE. (Fuel Element Development as a Physical-Technical Problem). Kummerer, K. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). 14p. (In German).

A survey of the requirements for fuel elements for the various types of reactors is given; emphasis is placed on the fast breeder reactor. Fuel element and cladding characteristics are described. Design considerations and development are outlined. Typical design data for fast breeder reactors are tabulated. (M.L.S.)

33093 (KFK-700(Pt. II)) BRENNSTOFFAUSWAHL. (Fuel Material Selection). Karsten, G. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). 19p. (In German).

Fabrication methods are tabulated for the various types of fuel materials; the methods are described. Characteristics of ceramic and metallic fuels are tabulated; thermal data are given for various types of fuels. Compatibility of ceramic fuels with air, water, sodium, and austenitic steel is summarised. 31 references. (M.L.S.)

33094 (KFK-700(Pt. IV)) DIE TEMPERATURVERTEILUNG IM BRENNELEMENT. (Temperature Distribution in Fuel Elements). Kaempf, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). 38p. (In German).

A quantitative method for treatment of the temperature distribution in reactor fuel elements is given. Models for axial and radial temperature distributions are included. Effects of coolant and fuel element radius on fuel temperature are described. Heat transfer and thermal efficiency calculational techniques are given. 13 references. (M.L.S.)

33095 (KFK-700(Pt. V)) DAS BETRIEBSVERHALTEN EINES BRENNELEMENTSTABES. (Fuel Rod Performance). Karsten, G. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). 28p. (In German).

Factors causing variations in fuel element performance are discussed; heat transfer analyses are detailed. Thermal characteristics of the fuel rods are described; methods for calculating thermal conductivity and thermal expansion are given. Swelling rate and melting loss models are formulated; liberation of fission product gas is described. Effects of fuel pressures and fuel-clad contact are analysed. 43 references. (M.L.S.)

33096 (KFK-700(Pt. VI)) TRANSPORTERSCHEINUNGEN IM OXIDISCHEN BRENNSTOFF. (Transport Model of Oxide Fuels). Blank, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). 20p. (In German).

A mass transport model for oxide fuels is given. The condition of the fuel under irradiation is examined; diffusion coefficients are determined. Fission rate effects are evaluated. Low temperature plasticity under irradiation and the effects of free gas atoms on defect concentration are discussed in detail. 23 references. (M.L.S.)

33097 (KFK-700(Pt. XIII)) THEORETISCHE BEZIEHUNGEN FUER BRENNELEMENTAUSLEGUNG UND BRENNELEMENTKOSTEN. (Theoretical Equations for Fuel Element Design and Costs). Kummerer, K. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). 31p. (In German).

Total specifications from volume balances are given; limits on total expansion volume balances and separate expansion volume balances are derived. Definitions of fuel costs are given; parametric analyses of fuel and blanket costs are detailed. Results of calculations are shown graphically. (M.L.S.)

33098 (LA-3936) MASS TRANSFER OF OXYGEN IN SODIUM COLD TRAPS. McPheeters, Charles C. (Los Alamos Scientific Lab., N. Mex.). May 1968. Contract W-7405-eng-36. 64p. Dep. CFSTI.

Low temperature precipitation of CO is a method of removing O_2 from solution in liquid Na commonly called cold trapping. NaO precipitation is assumed to be a heterogeneous process because of the strong effect of surface area on the rate of precipitation. Growth of crystals from a super-saturated solution is said to proceed according to the equation $dm/dt = kA(C - C_e)$ where dm/dt is the rate of O_2 accumulation on the crystal, k is an overall mass transfer coefficient including a diffusion step and a surface deposition step, A is the crystal surface area, C is the O_2 concentration in the bulk stream, and C_e is the equilibrium O_2 concentration at the temperature of the crystal. Mass transfer coefficients were calculated by measuring the rates of O_2 concentration changes during cold trapping runs and by correlating these rates with the surface area available for precipitation. The mass transfer coefficient was found to be a function of both Reynolds number and temperature. The effect of Reynolds number on the coefficient indicated that the process was diffusion controlled. Arrhenius plots of the coefficients indicated that the activation energy for precipitation was approximately 3 kcal/mole. This activation energy is in fair agreement with that for diffusion of O_2 in Na which is approximately 2.4 kcal/mole. The mass transfer coefficients calculated were of the order of 10^{-5} g O/cm^2-h-ppM. 39 references. (auth)

33099 (ORNL-TM-2179) PRESTRESSED CONCRETE REACTOR VESSEL RESEARCH AND DEVELOPMENT PROGRAM SUMMARY. Whitman, G. D. (Oak Ridge National Lab., Tenn.). Apr. 1, 1968. Contract W-7405-eng-26. 46p. Dep. CFSTI.

A research and development program in support of prestressed concrete pressure vessels for central station nuclear power plant application is described. The program is planned to be in support of the general technology with particular emphasis on defining and investigating areas involving potential safety problems. Activities initiated and planned include work on analytical methods development, materials investigations, model experiments, components development, construction methods development, surveys of the literature, and studies of special problems. 27 references are included. (auth)

33100 (RT/ING-(68)4) SIMULABILITA FUORI PILA DEL FENOMENO DI INTASAMENTO DEL MANTELLO DI UN COMBUSTIBILE APERTO AL REFRIGERANTE. (Out-of-Pile Simulation of Blanket Element Cooling Channel Blockage). Segre, G. J.; Sartori, S. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1968. 175p. (In Italian). Dep.

Out-of-pile simulation of fission product release and transport in reactors is described. Permeability of fuel materials is considered; the effects of change of permeability are analysed. The models used for determination of fission product movement are given. Effects of physical characteristics of the fuel materials are considered; pressure effects are analysed. Results of calculations are tabulated. The chemical behavior of the fission products is discussed; results of deposition studies are tabulated. Fission product buildup effects on fuel swelling are analysed. (M.L.S.)

33101 (WAPD-TM-428) FLOT-1: FLOW TRANSIENT ANALYSIS OF A PRESSURIZED WATER REACTOR DURING FLOW COASTDOWN. Fuls, G. M. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Apr. 1968. Contract AT(11-1)-Gen-14. 48p. Dep. CFSTI.

A description of the FLOT-1 (MO219) digital computer program for the prediction of the flow transient in a multiloop, multibranch, pressurized water reactor resulting from the partial, total, or sequential loss of power to the operating pumps is presented. The most significant parameter in the rate of flow coastdown is the kinetic energy in the pump rotor. A new empirical method of treating the transfer of energy from the pump rotor to the fluid is developed. Accurate prediction of the flow coastdown permits optimization of core power for maximum safe operation. The accuracy of this method of prediction is verified by correlation of predicted results with test data for the PWR at the Shippingport (Pa.) Power Station. (auth)

33102 EXPERIENCES WITH A TELEVISED NUCLEAR ENGINEERING SEMINAR PROGRAM. Babb, A. L.; McCormick, N. J.; Woodruff, G. L. (Univ. of Washington, Seattle). Trans. Amer. Nucl. Soc., 11: 44(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33103 THE NEW CURRICULUM IN NUCLEAR ENGINEERING AT UCB. Olander, D. R.; Ruby, L. (Univ. of California, Berkeley). Trans. Amer. Nucl. Soc., 11: 44-5(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33104 A DIFFERENT APPROACH TO THE FIRST COURSE IN REACTOR NUCLEAR PHYSICS. Bridgman, Charles J.; Booth, Ray S. (Air Force Inst. of Tech., Dayton, Ohio). Trans. Amer. Nucl. Soc., 11: 45-6(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33105 NUCLEAR MATERIALS MANAGEMENT: A COURSE OF STUDY. Chezem, Curtis G. (United States Atomic Energy Commission, Washington, D. C.). Trans. Amer. Nucl. Soc., 11: 46(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33106 TIME-SHARING COMPUTERS IN NUCLEAR ENGINEERING EDUCATION. Graham III, W. Waverly; Patrick, Robert F. (Georgia Inst. of Tech., Atlanta). Trans. Amer. Nucl. Soc., 11: 46-7(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33107 "THIS ATOMIC WORLD:" AN EFFECTIVE UNIVERSITY NUCLEAR EDUCATION EXTENSION PROGRAM. Napp, Fredrick P. (Oak Ridge Associated Universities, Tenn.); Kiker, William E. Trans. Amer. Nucl. Soc., 11: 47-8(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33108 APPLICATION OF ASYMPTOTIC DIFFUSION THEORY METHODS TO SMALL SYSTEMS, ADAPTATION OF ZOOM. Doyas, R. J.; Koponen, B. L.; Hampel, V. E. (Univ. of California, Livermore). Trans. Amer. Nucl. Soc., 11: 206-8(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33109 KORROZIONNAYA STOYKOST' REAKTORNYKH MATERIALOV; SPRAVOCHNIK. (Corrosion Resistance of Reactor Materials; a Handbook). Gromova, A. I.; Kuznetsova, V. N.; Morozova, I. K.; Pavlova, F. S.; Parfenov, B. G.; Rodchenkov, B. S.; Sabinin, A. A.; Smirnov, V. V.; Shuvalov, V. A. Moscow, Atomizdat, 1966. 504p.

Presented is a handbook intended for engineering personnel of design bureaus and plants concerned with the design, building, and operation of atomic reactors. The book is an attempt to classify data on the corrosion resistance of materials used in atomic reactor building. The data were obtained by experiments conducted by the authors and from Soviet and non-Soviet publications. (ATD)

33110 NUCLEAR REACTOR FUEL ELEMENT ASSEMBLIES. Leaver, Bernard (to United Kingdom Atomic Energy Authority). British Patent 1,114,707. May 22, 1968. Filed Sept. 29, 1964.

A reactor fuel element assembly of the kind comprising a cluster of end supported, spaced, parallel, and sheathed fuel elements includes at least one element retaining member spaced from one end of the cluster and lying transversely on projected longitudinal axes of fuel elements so that extension of the cluster due to fracture of the fuel elements is limited. The assembly includes a cellular grid for slidably guiding an end of each fuel element within the cell. A wire carried by this grid serves as the retaining member for the element. (B.L.M.)

33111 NUCLEAR REACTOR FUEL ELEMENT ASSEMBLIES. Ridgway, James; Haslam, Robert James; Leaver, Bernard (to United Kingdom Atomic Energy Authority). British Patent 1,114,706. May 22, 1968. Filed Sept. 29, 1964.

A method is described for fabricating a reactor fuel element assembly made up of a cluster of parallel fuel elements in which each element is secured to a support at one end and spaced from its neighboring elements by cellular grids at the other end and intermediate the ends of the cluster. Each element is enclosed in a sheath having a generally smooth outer surface except for discrete pads solely in the locality of the grids for spacing the sheath outer surfaces from the grids. The pads may be attached to the sheaths by conventional methods, such as brazing or welding, or may be formed as an integral part with the sheath. (B.L.M.)

33112 IMPROVEMENTS IN NUCLEAR FUEL ELEMENTS. Roberts, William Hawkridge; Turner, Stuart (to United Kingdom Atomic Energy Authority). British Patent 1,114,696. May 22, 1968. Filed Aug. 20, 1965.

A vented nuclear fuel element is made up of a fissile member, a containment for enclosure of this member, and decay path means within the containment. The decay path means comprises a series of chambers, each adapted to contain a discrete liquid seal to serve as a time delay for the radioactive gases or vapors before they are vented out. (B.L.M.)

33113 IMPROVEMENTS IN OR RELATING TO VAPOUR GENERATING AND SUPERHEATING PLANT. Prasher, Charles Lindsay; Worley, Norman George; Taylor, Anthony James (to Babcock and Wilcox Ltd.). British Patent 1,114,673. May 22, 1968. Filed Nov. 25, 1963.

A vapor generating and superheating plant includes a nuclear reactor coolant used as a heating medium for a once-through-forced-flow boiler adapted to generate and superheat vapor in tubes. The composition of the tubes varies over the length of the tubes in order to enable the tubes to withstand the temperatures to which they will be subjected during service. Upstream in the coolant flow path are positioned heat exchange surfaces of metal of lower heat resistance. The cooling effect of these surfaces on the coolant at a given load is variable so that the coolant temperature of the metal of lower heat resistance may, as the load falls over a range from the maximum continuous rating, be limited to a safe value. (B.L.M.)

33114 IMPROVEMENTS IN AND RELATING TO VAPOUR GENERATORS. Williamson, Malcolm Richard (to United

Kingdom Atomic Energy Authority). British Patent 1,115,077. May 22, 1968. Filed June 29, 1964.

In a nuclear reactor/steam generator system tubes heated by primary coolant circulated through the reactor core make up a heating surface for generating the steam and are contained in the same vessel as the reactor core. These tube modules, which constitute the heating surfaces, are closely and uniformly positioned in an annular chamber in the upper part of the vessel. The primary coolant is so directed through this chamber as to flow over the modules. Downcomers of the modules are located in the chamber to occupy the spaces left vacant between the modules and the chamber walls and/or between adjacent modules. The downcomers and modules are arranged in a substantially hexagonal cross section and in such a way that substantially no paths of low flow resistance are left for the primary coolant. (B.L.M.)

33115 IMPROVEMENTS IN AND RELATING TO VAPOUR GENERATORS. Williamson, Malcolm Richard; Wood, Albert Geoffrey (to United Kingdom Atomic Energy Authority). British Patent 1,115,076. May 22, 1968. Filed June 29, 1964.

In a nuclear reactor/steam generator system in which the surfaces for generating steam are housed in the same vessel as the reactor core and are heated by primary coolant circulated through the core, the heating surfaces are made up of tubes disposed in the upper part of the vessel and extending substantially parallel to the axis of the chamber. The tubes are grouped into a number of banks separated by partitions, which divide the chamber into several compartments sectorially. Each compartment has primary inlet and outlet openings adjacent to opposite extremities of the compartment. The openings are offset relative to one another when viewed in the direction of the chamber axis to give the primary coolant a cross flow component over the tubes. (B.L.M.)

33116 IMPROVEMENTS IN AND RELATING TO VAPOUR GENERATORS. Heathcote, John (to United Kingdom Atomic Energy Authority). British Patent 1,115,075. May 22, 1968. Filed June 29, 1964.

An integrated nuclear reactor/steam generator system is described in which heating surfaces at which the steam is generated are housed in the same vessel as the core of the reactor and are heated by a primary coolant passed through the core. The heating surfaces are made up of tubes connected between an inlet and an outlet, which are in turn connected to a steam circuit situated outside the vessel. This steam circuit includes one of more forced circulation pumps and is characterized by an auxiliary boiler to provide a store of steam under pressure that can be injected as required into the outlet header to promote circulation through the tubes should the forced circulation pump(s) fail. A by-pass is provided across the forced circulation pump(s) and a normally closed valve in the by-pass is openable to reduce the pressure drop across the pump(s) during a failure. (B.L.M.)

33117 IMPROVEMENTS IN AND RELATING TO VAPOUR GENERATORS. Heathcote, John (to United Kingdom Atomic Energy Authority). British Patent 1,115,074. May 22, 1968. Filed June 29, 1964.

An integrated nuclear reactor/steam generator system is described in which the heating surfaces at which the steam is generated are housed in the same vessel as the core of the reactor and are heated by a primary coolant passed through the core. The heating surfaces are made up of tubes in an annular chamber in the upper part of the vessel, and the tubes are disposed at substantially right angles to an axis of the vessel and are connected between headers substantially parallel to that axis. The tubes are supported by upright support members and spacers. The upper portion of the vessel together with the headers and tubes are removable as one piece from the rest of the vessel. (B.L.M.)

33118 IMPROVEMENTS IN AND RELATING TO PRESSURE VESSELS. Williamson, Malcolm Richard (to United Kingdom Atomic Energy Authority). British Patent 1,115,078. May 22, 1968. Filed June 29 1964.

A pressure vessel for a nuclear reactor also encloses heating surfaces at which steam is generated and which are positioned in a chamber in the upper part of the pressure vessel. The outer wall of the chamber is defined by a trunk, which also defines with the vessel a flow path for return of the primary coolant from the heating surfaces to the core of the reactor. The steam generating tubes constituting the heating surfaces are suspended from and removable with the lid of the vessel and either the trunk or an upper part of it. A sealed joint is provided either between the trunk and shielding of the reactor core or between the upper part and the rest of the trunk. The joint is sealed with an O ring seal between grooves in the flange members on the two parts to be connected. (B.L.M.)

33119 MODULAR SUPPRESSION TANKS FOR NUCLEAR CONTAINMENT STRUCTURES. (to Chicago Bridge and Iron Co.). British Patent 1,113,080. May 8, 1968. Priority date May 10, 1966, United States.

A pressure suppression containment system is described for a nuclear reactor for generating heat and having a drywell vessel with a water supply circulating through the drywell vessel and heated by the reactor into a high pressure steam supply. The containment system includes a number of suppression tanks spaced about the drywell vessel. Each tank contains a quantity of liquid, and a vent connects the drywell vessel with the inner portion of the tanks below the level of the liquid so that excess steam and pressure within the drywell vessel can be dissipated into the suppression tanks. Each of the suppression tanks includes special support means. (B.L.M.)

33120 IMPROVEMENTS IN AND RELATING TO NUCLEAR REACTOR PLANTS. (to Sulzer Brothers Ltd.). British Patent 1,114,652. May 22, 1968. Priority date Aug. 13, 1964, Switzerland.

A method is described of heating a working medium in the heat exchanger of a reactor by means of a heat carrier circulating through the reactor and the heat exchanger. The working medium passes through the heat exchanger in parallel component flows generally in countercurrent with the heat carrier in passages or coils arranged so that points in the two passages at equal distances along the passages are situated at places in which the heat carrier has substantially the same temperature. At full load the rate of the component flows is equal and at partial load the rate of one component flow is less than that of another. Control feed valves are provided in the parallel pipe coils. (B.L.M.)

33121 IMPROVEMENTS IN OR RELATING TO A FUEL ELEMENT ASSEMBLY FOR A NUCLEAR REACTOR. (to Atomic Energy Board). British Patent 1,114,566. May 22, 1968. Priority date June 11, 1964, South Africa.

A reactor fuel element assembly is made up of a tubular fuel container having at least two coolant ducts disposed longitudinally through the fuel container with the fuel around the coolant ducts. One duct is for coolant supply and the other for coolant withdrawal. The fuel may be granular and the coolant is a liquid metal coolant. The coolant ducts have a number of longitudinally spaced ports communicating with the fuel space. A number of these fuel element assemblies and a heat exchanger can be combined to form replaceable units. (B.L.M.)

33122 FIZICHESKIYE ISSLE O ANIYA ZASHCHITY REAKTOROV. (Physical Investigation of Reactor Shielding). Kazanskii, Yu. A.; Kukhtevich, V. I.; Matusevich, E. S.; Sinitsyn, B. I.; Tsypin, S. G. Moscow, Atomidat, 1966. 390p.

Examined in detail are the characteristics of radiation inside and outside of a biological shield. Empirical data required for design of modern reactor shielding are analyzed and generalized. Spatial, energy and angular distribution of gamma and neutron radiation in the shielding is discussed. Formation and methods of gamma-radiation capture, and scattering of gamma-quanta and neutrons in air and from the ground are explained. A good deal of attention is devoted to comparison of experimental and computed data. Modern installations and instruments for investigation of shielding and methods for obtaining experimental data are described. (JPRS)

33123 KRITICHESKIYE PARAMETRY SISTEM S DELYASHCHIMISYA VESHCHESTVAMI I YADERNAYA BEZOPASNOST'; SPRAVOCHNIK. (Critical Parameters of Systems With Fissionable Materials and Nuclear Safety; a Handbook). Dubovskii, B. G.; Kamaev, A. V.; Kuznetsov, F. M.; (and others). Moscow, Atomizdat, 1966. 225p.

Presented is a handbook intended for specialists concerned with the problems of assuring nuclear safety, for persons calculating, designing, operating, and studying the physics of nuclear reactors of various types, and for students in associated departments. Methods of creating and maintaining conditions which will exclude the possibility of an accidental chain reaction during the processing, storage, and transportation of fissionable materials are discussed. The book is based mainly on the results of studies published before 1965. In addition to information on critical parameters of systems with fissionable materials, the fundamental concepts of criticality, principles for assuring nuclear safety, a review of cases of the occurrence of uncontrolled chain reactions, and the basic standards for nuclear safety are included. (ATD)

33124 MONTE CARLO AND EXPERIMENTAL ANALYSES OF NUCLEAR REACTOR FLUCTUATION MODELS. Zolotar, Burt Alan. Ithaca, N. Y., Cornell Univ., 1967. 124p.

Thesis.

The one-mode model stochastic nuclear reactor model has been proposed by Bell to study fluctuations in neutron populations. The purpose of this model is to allow consistent space and energy corrections to point reactor stochastic results. The model has been extended to also cover fluctuations in captures and fissions. A time dependent, Monte Carlo computer program has been developed to simulate these fluctuations for a one velocity, bare reactor system and to estimate parameters of the probability distributions. It has been shown that the one-mode model for neutron populations and captures gives excellent agreement with the Monte Carlo results. Both showed a correction of about 50% to the magnitude of the variance predicted by basic point reactor equations. The fission probabilities required a more careful examination, but the Monte Carlo results could be predicted by approximate solutions to the exact stochastic equations. The influence of spatial effects on the properties of persisting and nonpersisting chains in supercritical systems has also been examined. The one-mode model provides important corrections. This model has been applied to fluctuation experiments on the Cornell University Zero Power Reactor. It was possible to extend the point reactor theory of Babala to include space and energy dependence. This extension provided excellent predictions of the parameters measured in the Rossi-alpha and waiting time experiments. (Disser. Abstr.)

33125 ULTIMATE STRENGTH ANALYSIS OF PRESTRESSED CONCRETE PRESSURE VESSELS. Rashid, Y. R. (Gulf General Atomic Inc., San Diego, Calif.). Nucl. Eng. Design, 7: 334-44 (1968).

A method of analysis of prestressed concrete pressure vessels subjected to pressure overload is presented. The method is based on the finite element variational procedure. A cracking criterion for concrete is discussed in detail. The steel elements are assumed to be elastic perfectly plastic. Von-Mises yield criterion and Prandtl-Reuss flow equations define the behavior of the liner in the range of plastic deformations. The constitutive and equilibrium equations of the three types of elements utilized in the structure namely, concrete, uniaxial steel and liner elements, are derived. These equations are valid throughout the entire range of deformations. The case considered is one which involves axisymmetric and plane states of stress only. A step-by-step solution procedure, by which the pressure is applied incrementally, is adopted. The utility of the method is demonstrated by an example; and a limited experimental correlation is given. (auth)

33126 DIFFUSION MODEL FOR RELEASE OF FISSION PRODUCTS FROM COATED PARTICLE FUELS. Dunlap, R. W.; Gulden, T. D. (Gulf General Atomic Inc., San Diego, Calif.). Nucl. Sci. Eng., 32: 407-16(1968).

A parametric study of a two-zone diffusion model has been performed to describe in-pile diffusion-controlled release of fission products from spherical coated fuel particles. Both the steady-state release and the times to reach steady state are considered. The effects of variations in diffusion coefficients of the fuel and coating, coating thickness, partition coefficient at the fuel-coating interface, contamination fraction, and decay constant have been considered. The results predict three regimes of release for different ranges of half-life and diffusion coefficients. Certain very long-lived isotopes will have high equilibrium release rates controlled by diffusion in the fuel core but probably will not come to equilibrium during the lifetime of a fuel particle. The release of many isotopes with intermediate half-lives is controlled by diffusion in the coating material. Equilibrium release rates in this range are large and probably will be achieved in practice for pyrolytic carbon coated fuel particles. The release of the inert gases is controlled by the level of fuel contamination in the coating material. The beneficial effects of using improved barrier coatings are discussed in terms of the diffusion model. Certain unusual aspects of the in-pile release of fission gases are explained in terms of the results of this model. 21 references. (auth)

33127 ASYMPTOTIC SOLUTIONS TO THE TRANSPORT EQUATION FOR A PLANE LATTICE. Leonard, A. (Stanford Univ., Calif.). Nucl. Sci. Eng., 32: 342-9(1968).

A transport calculation of the lattice diffusion length, yielding the gross decay of the asymptotic flux in a lattice, is made using the method of K. M. Case. Refinements over the diffusion calculation are shown to be slight adjustments in the slab widths due to boundary effects, and the appearance of exact homogeneous diffusion lengths as calculated by transport theory. The extension to asymptotic time-dependent problems is also given. For the neutron-wave problem, the complex-valued diffusion length is derived as a function of frequency, and the relation between the time decay constant and the buckling is given for the pulsed-neutron problem. Limiting cases involving very wide slabs are discussed. Finally, some experiments are briefly described for which analysis might be applicable. 13 references. (auth)

33128 CALCULATIONS OF PHYSICS PARAMETERS FOR MIXED FUEL-TARGET LATTICES. Agee, L. J. (Douglas United Nuclear, Inc., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 249-50(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33129 SINGULAR PERTURBATION METHODS AND NONLINEAR BOUNDARY VALUE PROBLEMS. Canosa, Jose (IBM Scientific Center, Palo Alto, Calif.); Cole, Julian. Trans. Amer. Nucl. Soc., 11: 231-2(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33130 ANALYSIS OF AN INITIAL VALUE PROBLEM FOR THE NEUTRON TRANSPORT EQUATION WITH DELAYED NEUTRONS. Hendry, W. L.; Bell, G. I. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc., 11: 232(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33131 APPLICATIONS OF MONTE CARLO METHODS AT KNOLLS ATOMIC POWER LABORATORY. Mendelson, M. R. (General Electric Co., Schenectady, N. Y.). Trans. Amer. Nucl. Soc., 11: 309(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33132 DEVELOPMENT AND USE OF MONTE CARLO TECHNIQUES IN REACTOR DESIGN AT UNITED NUCLEAR CORPORATION. Nakache, F. R. (United Nuclear Corp., Elmsford, N. Y.). Trans. Amer. Nucl. Soc., 11: 310(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33133 THE APPLICATION OF MONTE CARLO TO NEUTRON TRANSPORT AND REACTOR ANALYSIS PROBLEMS AT THE EURATOM RESEARCH CENTER ISPRA. Rief, H. (EURATOM, Ispra, Italy). Trans. Amer. Nucl. Soc., 11: 310-11(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33134 BAPL USE OF MONTE CARLO IN NUCLEAR DESIGN AND ANALYSIS. Candelore, N. R.; Gast, R. C. (Westinghouse Electric Corp., West Mifflin, Pa.). Trans. Amer. Nucl. Soc., 11: 309(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33135 A RECURSIVE SOLUTION OF THE B_1 EQUATIONS. Archibald, R.; Mathews, D. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc., 11: 312(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33136 FAST TECHNIQUE FOR J-FUNCTION AVERAGING. Helholtz, J.; Livolsi, A. Z.; Roy, D. H. (Babcock and Wilcox Co., Lynchburgh, Va.). Trans. Amer. Nucl. Soc., 11: 312-13 (June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33137 BOUNDARY CONDITIONS AT NONDIFFUSION SURFACES IN MULTIGROUP DIFFUSION CALCULATIONS. Pellaud, Bruno (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc., 11: 313-14(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33138 APPROXIMATION TO THE ADJOINT CONSTRUCTED FROM THE FLUX. Wade, David C. (General Electric Co., Schenectady, N. Y.). Trans. Amer. Nucl. Soc., 11: 314(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33139 EXTREMUM VARIATIONAL PRINCIPLES FOR THE MONOENERGETIC TRANSPORT EQUATION WITH ARBITRARY ADJOINT SOURCE. Buslik, A. J. (Westinghouse Electric Corp., West Mifflin, Pa.). Trans. Amer. Nucl. Soc., 11: 315 (June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33140 MACROSCOPIC FORMULATION OF TRANSPORT THEORY. Pfeiffer, W. W.; Shapiro, J. L. (California Inst. of Tech., Pasadena). Trans. Amer. Nucl. Soc., 11: 315-17(June 1968).

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33141 NUMERICAL SOLUTIONS OF THE SINGULAR INTEGRAL FORM OF THE NEUTRON TRANSPORT EQUATION. Bowden, R. L.; Bullard, A. G. (Virginia Polytechnic Inst., Blacksburg, Va.). Trans. Amer. Nucl. Soc., 11: 317-18(June 1968).

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33142 HIGH-HEAT-FLUX ELECTRON-BOMBARDMENT HEATING EXPERIMENTS. Carlson, Roger D.; Holtz, Robert E. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 325(June 1968).

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33143 CLEANING TECHNIQUES FOR SODIUM SYSTEM COMPONENTS. Poucher, F. W.; Kohl, A. L. (Atomics International, Canoga Park, Calif.). Trans. Amer. Nucl. Soc., 11: 114-15(June 1968).

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33146 FUNDAMENTAL STUDIES FOR EMERGENCY COOLING OF REACTOR FUEL ELEMENTS. 1. STUDIES ON THE LIQUID FILM COOLING. Hasegawa, Shu; Shimomura, Hiroaki (Kyushu Univ., Japan). Kyushu Daigaku Kogaku Shuho, 40: 323-30(June 1967). (In Japanese).

The breakage of a liquid film falling along the outer surface of a tubular body was studied for both the constant-temperature and the heated flows, especially the relation between the (minimum) critical flow for this occurrence and the heat flux. A study was also made on the phenomenon appearing when the liquid film flows down the surface of a high-temperature tube. The results obtained are as follows: the analysis of Nusselt is useful for the laminar flow while the laminar-turbulent flow relies on Dukler-Bergelin analysis; the contact angle with the solid surface appears to have a large influence in the critical flow for constant-temperature liquid films; in the critical flows for heated liquid films there exists both stable and unstable film breakages related to the film Reynolds number; and the velocity with which the top of a liquid film moves down the surface of a heated tube may be related to the data on the behavior of a liquid drop dropped onto the heated plate. (NSA of Japan)

33147 EFFECT OF NEW CROSS-SECTION DATA ON CALCULATED NEUTRON CAPTURES IN HAFNIUM CONTROL RODS. Itkin, I.; Butler, J. D.; Connors, D. R. (Westinghouse Electric Corp., West Mifflin, Pa.). Trans. Amer. Nucl. Soc., 11: 302 (June 1968).

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33148 FLUX DEPRESSION IN A PARALLEL ARRAY OF CYLINDRICAL ABSORBERS SANDWICHED BETWEEN TWO PARALLEL PLANES. Crawford, Bruce W.; Friedman, Jack P.; Hansen, Eric C.; Judge, Frank D. (General Electric Co., Schenectady, N. Y.). Trans. Amer. Nucl. Soc., 11: 303-4(June 1968).

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33151 CORROSION BEHAVIOR OF COBALT, IRON, AND MOLYBDENUM BASE ALLOYS IN HIGH-TEMPERATURE SODIUM. Romano, A. J.; Wachtel, S. J.; Klamut, C. J. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc., 11: 118(June 1968).

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33152 CORROSION OF OXYGEN-CONTAMINATED Nb–1Zr AND Ta–8W–2Hf ALLOYS BY REFLUX-BOILING SODIUM AT 1095°C. Romano, A. J.; Klamut, C. J. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc., 11: 118-20(June 1968).

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33153 MASS TRANSFER OF OXYGEN IN SODIUM COLD TRAPS. McPheeters, Charles C. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc., 11: 116-17(June 1968).

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33156 SOME RECENT DATA ON INCIPIENT SODIUM BOILING. Holtz, R. E.; Singer, R. M. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 332(June 1968).

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33157 PULSED-NEUTRON RESEARCH IN MODERATORS. Corngold, Noel (California Inst. of Tech., Pasadena). Trans. Amer. Nucl. Soc., 11: 40(June 1968).

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33158 GENERALIZED FORMULATION OF REACTOR KINETICS. Becker, Martin (Rensselaer Polytechnic Inst., Troy, N. Y.). Trans. Amer. Nucl. Soc., 11: 225(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

33159 INFLUENCE OF THE SHAPE-FUNCTION TIME DERIVATIVE ON SPATIAL KINETICS CALCULATIONS IN FAST REACTORS. Meneley, D. A. (Argonne National Lab., Ill.); Ott, K. O.; Wiener, E. S. Trans. Amer. Nucl. Soc., 11: 225-6(June 1968).

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33162 RESULTS OF THERMOCOUPLE CALIBRATION IN A PULSED REACTOR. Dau, Gary J.; Bourassa, Ronald R.

(Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc., 11: 341-2(June 1968).
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33166 APPLICATION OF FOURIER TRANSFORMS TO THE ANALYSIS OF SPECTRA DATA. Inouye, T.; Harper, T.; Rasmussen, N. C. (Massachusetts Inst. of Tech., Cambridge). Trans. Amer. Nucl. Soc., 11: 415(June 1968).
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33169 IRRADIATION EFFECTS IN PRESSURE-VESSEL STEELS: VARIATIONS BETWEEN DIFFERENT HEATS AND DIFFERENT FABRICATION PROCEDURES. Grounes, M. (AB Atomenergi, Studsvik, Sweden). Trans. Amer. Nucl. Soc., 11: 149-50(June 1968).
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33170 EXPERIMENTAL WELDING DEVELOPMENTS FOR POWER REACTORS. Grant, S. P. (Babcock and Wilcox Co., Lynchburg, Va.). Trans. Amer. Nucl. Soc., 11: 139(June 1968).
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33176 FLOW-INDUCED VIBRATION OF HEAT-EXCHANGER TUBES. Wambsganss, M. W. Jr. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 348-9(June 1968).
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33177 NEW APPROACH TO VOID GENERATION IN SUBCOOLED BOILING. Schmidt, Reiner (Westinghouse Electric Corp., Madison, Pa.). Trans. Amer. Nucl. Soc., 11: 349-50 (June 1968).
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33178 EXPERIMENTAL STUDY OF THE VIBRATION OF FLEXIBLE CYLINDERS INDUCED BY AXIAL FLOW. Paidoussis, M. P. (McGill Univ., Montreal). Trans. Amer. Nucl. Soc., 11: 352-3(June 1968).
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33179 THERMAL FLUX TRAP FOR PLUTONIUM RECYCLE ASSEMBLIES. Tulenko, James S. (United Nuclear Corp., Elmsford, N. Y.). Trans. Amer. Nucl. Soc., 11: 355(June 1968).
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33180 FORCE-REFLECTING SERVOMECHANISM WITH SIGNAL DELAY. Thompson, William M. (Argonne National Lab., Ill.); Vacroux, Andre G. Trans. Amer. Nucl. Soc., 11: 361-2(June 1968).
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33181 PROPAGATION VELOCITY OF PRESSURE WAVES IN TWO-PHASE MIXTURES AND THE DEPENDENCY ON FLOW REGIMES. Henry, R. E.; Fauske, H. K. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 364-5(June 1968).
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33182 PROPAGATION OF RAREFACTION WAVES THROUGH TWO-PHASE, TWO-COMPONENT MEDIA. Hamilton, L. J.; Schrock, V. E. (Univ. of California, Berkeley). Trans. Amer. Nucl. Soc., 11: 367-8(June 1968).
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33183 CRITICALITY CALCULATIONS FOR FUEL STORAGE ARRAYS IN WATER. Fox, J. K. (Idaho Nuclear Corp., Idaho Falls). Trans. Amer. Nucl. Soc., 11: 384-5(June 1968).
From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

GENERAL

33184 (BNWL–733) A PRELIMINARY EVALUATION OF THE THERMAL EFFECTS OF THE BEN FRANKLIN DAM PROJECT ON COLUMBIA RIVER TEMPERATURES BELOW THE HANFORD PLANT. Jaske, R. T. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 1968. Contract AT(45-1)-1830. 43p. Dep. CFSTI.

The planned construction of the Ben Franklin project below the Hanford production reactors poses the question of determining to what extent this project will affect the Columbia River temperatures. Using the plant operations record for the year 1966, and the weather record for the same period, a series of simulation runs was made to determine the effects of the dam on the temperature regime, and the extent to which density currents could be expected to develop. This information is to be used as background for the later evaluation of the modification of the existing radionuclide discharge. The digital simulation model, COL HEAT, was used. This model has been previously developed for use in the regional evaluation of the effects of the Hanford plant. Operations with the model, using the data period indicated, showed that: the existence of the proposed project would have nominal effect, tending towards a slight increase in downstream temperature for both the 385 and 400-ft pool elevations. Under some conditions, in critical temperature seasons (April and September), plant operations cause amplification of the temperature transients associated with stream regulations and plant load factor; that the 385-ft pool can be considered a channel flow case for estimating travel time. However, density currents could be expected in the 400-ft pool for most of the summer months, thus causing decreased travel time and relatively adiabatic thermal conditions for the main flow system at the lower end of the reservoir. (auth)

33185 (CERN–68–15) MONTE CARLO PHASE SPACE. Lectures Given in the Academic Training Programme of CERN. James, F. (European Organization for Nuclear Research, Geneva (Switzerland)). May 1, 1968. 37p. Dep.

A general treatment of Monte Carlo techniques is presented with gradual specialization on the one-dimensional integral, multidimensional integral, and the phase-space integral. (B.G.D.)

33186 (COO–614–61) ICR QUARTERLY REPORT NUMBER 16. Yngve, Victor H. (Chicago Univ., Ill. Inst. for Computer Research). Feb. 1, 1968. Contract AT(11-1)-614. 151p. Dep. CFSTI.

Recent developments in computer research at the University of Chicago are outlined. Topics discussed include project support activity, the man–machine project, PDP-8 I/O devices, phase counter and interface to the PDP-8 for an interferometer, the linguistic information analysis and retrieval system, essential features of purposive movements, cybernetic problems of sensorimotor structure, seeking mathematical models for skilled actions, and an aspect of robot control and nervous control of skilled movements: coordination of two effectors and transfer of adaptation. (W.H.K.)

33187 (ISS–66/50) IL SEMINARIO DEI LABORATORI DI FISICA NEL QUADRIMESTRE SETTEMBRE–DICEMBRE 1966. (The Seminar at the Physics Laboratory During the Period September–December 1966). (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). Dec. 30, 1966. 104p. (In Italian). Dep.

A synopsis of the lectures held at the Physics Laboratory during the period Sept.–Dec. 1966 is presented. The lecture topics include radiopreservation of foods, genetic studies on *E. coli*, research on central nervous system, nuclear structure studied by (p,2p) reactions, current algebra, summary of Berkeley and Gatlinburg conferences on elementary particle and nuclear physics, quantum electrodynamics at small distances, time reversal invariance and beta decay, symmetries in meson photoproduction, mechanical effects of magnetic resonance, and resonance methods for measuring total cross sections. (C.E.S.)

33188 (K–1746) GRADIENT PROJECTION METHOD FOR CONSTRAINED OPTIMIZATION. Cross, Kenneth E. (Union Carbide Corp., Oak Ridge, Tenn. Computing Technology Center). May 30, 1968. Contract W-7405-eng-26. 25p. Dep. CFSTI.

A description is made of the constraint portion of a nonlinear optimization program which was developed for the purpose of solving a series of engineering design and economic problems. Additional capabilities were incorporated into an existing gradient search program to enable the consideration of both linear and nonlinear, equality and inequality, constraints. A rather nontheoretical approach is attempted in describing both the philosophy and the mechanics involved in the constraint techniques. (auth)

33189 (NP–17470) MEMORIA ANUAL, 1966. (Annual Report, 1966). (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 191p. (In Spanish). Dep.

Topics covered include: central nuclear power plant, reactor fuels, production and control of radioisotopes, uses of radioisotopes, radiation sources, installations and equipment, operations, safety hazards, and service functions. (M.C.G.)

33190 (RFP–1143) EVALUATION OF A GAS MIXING SYSTEM. DeGrazio, Robert P.; Auge, Robert G. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). May 23, 1968. Contract AT(29-1)-1106. 9p. Dep. CFSTI.

Because of the need to obtain standard gas mixtures in concentrations ranging from parts per million to percent for infrared and gas chromatographic analysis, a gas mixing apparatus was developed. To evaluate its capability, the apparatus was used to prepare mixtures of different concentrations of gases. The mixed gases were analyzed by gas chromatography and infrared spectroscopy. The results of the analyses of the prepared mixtures were then compared statistically with standard mixtures of the same gases obtained commercially. The comparison of these analyses showed that the apparatus can effectively and reproducibly prepare gas mixtures over the ranges studied. The apparatus is described and the precision and accuracy data are presented. (auth)

33191 (STI/DOC–11(Vol.6)(No.1)) LIST OF BIBLIOGRAPHIES ON NUCLEAR ENERGY. (International Atomic Energy Agency, Vienna (Austria)). 1968. 33p. Dep.

A list of 140 bibliographies, either published or in preparation, on various aspects of nuclear science is presented. (W.H.K.)

33192 (UCRL–13329(App.A)) [RESPONSE OF EARTH DAMS TO SEISMIC DISTURBANCES]. APPENDIX A. INSTRUMENTATION. (Montana State Univ., Bozeman). Feb. 22, 1968. Contract W-7405-eng-48. 27p. Dep. CFSTI.

Seismometers and battery powered magnetic tape recorders are described for their use at each station at which ground motion was measured in Pre-Gondola II at Fort Peck Dam. (J.C.W.)

33193 (UCRL–13329(Pt.1)) RESPONSE OF EARTH DAMS TO SEISMIC DISTURBANCES. PART I. MOTION MEASUREMENTS ON FORT PECK DAM. Final Report. Keightley, W. O. (Montana State Univ., Bozeman). Feb. 22, 1968. 115p. Dep. CFSTI.

For Lawrence Radiation Lab., [Livermore], Calif.

Records are presented of motions of Fort Peck Dam caused by ½ ton explosions, 20 ton single charge explosions, and by a 140-ton row explosion twelve miles away. The ground motions recorded at one point due to the several explosions can be compared, the main variables being weight of explosive and depth of burial. The ground motions recorded at several points due to one explosion can be examined for evidence of wave propagation along the foundation and for evidence of motion of the dam. Comparison of the ratios of amplitudes of motions caused by different events is shown. Motions of the foundation and dam are described. (J.C.W.)

33194 (UCRL–50396) A PROGRAM LIBRARY SYSTEM FOR THE PDP-8 COMPUTER USING IBM-COMPATIBLE MAGNETIC TAPE. Uber, Donald C. (California Univ., Livermore. Lawrence Radiation Lab.). Mar. 13, 1968. Contract W-7405-eng-48. 26p. Dep. CFSTI.

A system that enables the user to create a large library of programs for the PDP-8 computer and that can be written on and called off IBM tape by name from the teletype is described. It also includes high-speed and low-speed BIN and RIM paper tape loaders that are also called in from the teletype. The entire system uses only the last page of memory. Programs may be subdivided into several records on tape, each with the same name. When a program is called, all records with that label are loaded into core which makes it possible to modify, correct, or add to programs by adding records of the same name to the library. A switch option permits programs to be relocated in core as they are loaded in; if a program is stored as several records, they may be individually relocated. (auth)

33195 (Y–1621) PLANNING, SCHEDULING, AND CONTROLLING AND ENGINEERING DESIGN GROUP. Choat, E. E. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). May 27, 1968. Contract W-7405-eng-26. 105p. Dep. CFSTI.

The objective of this study was to develop an improved planning, scheduling, and control system for use in an engineering design section, and to evaluate the effectiveness of this system with respect to changes in productivity. Prior to 1962, no formalized procedures for planning or for establishing a priority of work existed, but a formal scheduling procedure did exist. Early in 1962, a new planning, scheduling, and control system was developed and initiated. The system included a procedure for investigating new job assignments, the Critical Path Method technique to plan all jobs, a computerized scheduling program, and a control system built into a routine review procedure. To evaluate the effect of these changes, production records were analyzed to determine the productivity of the section for a period encompassing one year prior to the changes and four years after the changes. These data indicate that there was a significant decrease in the number of manhours spent per drawing produced following the initiation of the newly developed planning, scheduling, and control system. It is concluded that the changes made in the planning, scheduling, and control system have contributed significantly to this increase in productivity. Those elements that are viewed as having been improved and which might be expected to produce an increase in efficiency are: planning, scheduling, control, coordination, communications, job investigation, and job knowledge. (auth)

33196 TRANSACTIONS OF THE ASME. J. Eng. Ind., 89: 581-848(Nov. 1967). (CONF-670332).

A separate abstract is included for the one paper selected from the papers on vibrations theory and application. (M.L.S.)

For an abstract of the individual paper see: 32950.

33197 INDEX KWIC DES PROGRAMMES NUCLEAIRES. (KWIC Index of Nuclear Programmes). Bibliotheque ENEA de Programmes de Calculs. Ispra, Italy, ENEA Computer Programme Library, 1968. 81p.

Presented are a brief description, in KWIC index form, of all the programs which are now in the library, and also a brief description of some programs of general interest which have been offered to the library. Included in each KWIC entry is a reference to its abstract number, if it has been published in the abstract book, or alternatively, in the page and issue number of the newsletter where it has been briefly described. A copy of the program file is included at the end of the booklet so that additional information in a condensed form on each program is available. This may be used to see, among other things, whether a program is tested and thereby immediately distributable, or to see in which language or for what machine the program has been written. (auth)

33198 NUCLEAR LAW BULLETIN. SUPPLEMENT TO NO. 1. Nucl. Law Bull., Suppl. No. 1, 1-69(Feb. 1968).

A supplement to the first issue of the Nuclear Law Bulletin is presented. Topics include United Kingdom—Act of 1965 on Nuclear Installations and Norway—Draft Act on the Uses of Atomic Energy. (B.G.D.)

33199 SCOPE, MAGNITUDE, AND IMPLICATIONS OF THE UNITED STATES ANTIBALLISTIC MISSILE PROGRAM. HEARINGS BEFORE THE SUBCOMMITTEE ON MILITARY APPLICATIONS OF THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, NINETIETH CONGRESS, FIRST SESSION, NOVEMBER 6 AND 7, 1967. Washington, D. C., Joint Committee on Atomic Energy, 1968. 158p. GPO $0.45.

MISSILES—development of antiballistic, US program for
ATOMIC ENERGY, LEGAL ASPECTS—scope, magnitude, and implications of US antiballistic missile program
NUCLEAR WEAPONS—delivery systems for, US program for development of (R.C.K.)

33200 NUCLEAR LAW BULLETIN. SECOND SUPPLEMENT TO NO. 1. Nucl. Law Bull., Suppl. No. 1, 1-10(Apr. 1968).

A supplement to the first issue of the Nuclear Law Bulletin is presented. It is devoted to coming into force of the Paris Convention and to the French Bill on third party liability in the field of nuclear energy. (B.G.D.)

33201 INDUSTRIAL RADIOISOTOPE APPLICATIONS IN THE PHILIPPINES. Fries, Bernard A. Isotop. Radiat. Technol., 5: 332-4(Summer 1968).

A program was developed for introducing the use of radiotracers in Phillipine industry. The radiotracer methods used to measure water flow in a gold mine, intake and residence time of cooling water in the holdup pond of a soda ash plant, and petroleum refinery flow and leak rates are described. Several applications in glass and cement factories and study of water leakage from the Baguio City reservoir were discussed for future application of radioisotopes. (B.S.L.)

33202 GEOMETRIC PROGRAMMING: A NEW MATHEMATICAL PROGRAMMING TECHNIQUE. Federowicz, Alex J. (Westinghouse Research Labs., Pittsburgh). Trans. Amer. Nucl. Soc., 11: 176(June 1968).

From 14th Annual Meeting of the American Nuclear Society, Toronto. See CONF-680601.

Appendix I

JOURNAL LIST

The following list includes 1968 additions to the comprehensive list published in NSA, Volume 22, No. 1, January 15, 1968. In the future, comprehensive lists will be published once each year (in January), and current additions will be cumulated on a monthly basis (in alternate issues) until the next comprehensive list is issued.

The title abbreviations are based on the United States of America Standards Institute's REVISED AND ENLARGED WORD-ABBREVIATION LIST FOR USASI Z39.5–1963 AMERICAN STANDARD FOR PERIODICAL TITLE ABBREVIATIONS. Titles of journals that are scanned regularly for NUCLEAR SCIENCE ABSTRACTS are marked by an asterisk (*). Foreign-language journals identified by a dagger (†) are available in English translation. The original-language title for a translated journal is given in parenthesis after the English title.

Acta Anat. Nippon.
Acta Anatomica Nipponica
see Kaibogaku Zasshi
Acta Astron.
Acta Astronomica, Polska Akademia Nauk (formed by merger of Acta Astronomica, Ser. A; Ser. B; and Ser. C) *(Poland)*
Acta Entomol. Bohemoslov.
Acta Entomologica Bohemoslovaca *(Czechoslovakia)*
Acta Geod., Geophys. Montanistica
Acta Geodaetica, Geophysica et Montanistica *(Hungary)*
Acta Med. Iugoslav.
Acta Medica Iugoslavica *(Yugoslavia)*
Acta Pharm. Hung.
Acta Pharmaceutica Hungarica *(Hungary)*
Acta Pharm. Suec.
Acta Pharmaceutica Suecica *(Sweden)*
Acta Phys. Chem.
*Acta Physica et Chemica *(Hungary)*
Acta Polytech., Chem. Met. Ser.
Acta Polytechnica, Chemistry including Metallurgy Series *(Sweden)*
Acta Sci. Natur. Univ. Pekin.
Acta Scientiarum Naturalium Universitatis Pekinensis
see Pei Ching Ta Hsueh Hsueh Pao, Tzu Jan K'o Hsueh
Acta Univ. Carolinae, Med., Monogr.
Acta Universitatis Carolinae, Medica, Monographia *(Czechoslovakia)*
Acta Univ. Nankinensis Sci. Natur.
Acta Universitatis Nankinensis Scientiarum Naturalium
see Nan Ching Ta Hsueh Hsueh Pao, Tzu Jan K'o Hsueh
Acta Univ. Upsaliensis, Abstr. Uppsala Diss. Sci.
Acta Universitatis Upsaliensis, Abstracts of Uppsala Dissertations in Science *(Sweden)*
Advan. Contr. Syst.
Advances in Control Systems *(U. S.)*
Advan. Cryog. Eng.
Advances in Cryogenic Engineering *(U. S.)*
Advan. Nucl. Phys.
Advances in Nuclear Physics *(U. S.)*
Advan. Polym. Sci.
Advances in Polymer Science
see Fortschr. Hochpolym.-Forsch.
Advan. X-Ray Anal.
Advances in X-Ray Analysis *(U. S.)*
Aesthet. Med.
Aesthetische Medizin *(West Germany)*
Agr. Hokkaido
Agriculture in Hokkaido
see Hokuno
Agr. Res. (New Delhi)
Agricultural Research (New Delhi) *(India)*
Air Clean.
Air Cleaning
see Kuki Seijo
Air Water Pollut.
*Air and Water Pollution (formerly International Journal of Air Water Pollution) *(U. S.–England)*
Ala. J. Med. Sci.
Alabama Journal of Medical Sciences, The *(U. S.)*
Allg. Prakt. Chem.
Allgemeine und Praktische Chemie *(Austria)*
Alloy Dig. Zr-3
Alloy Digest Zr-3 *(U.S.)*
Amer. Dyestuff Rep.
American Dyestuff Reporter *(U. S.)*
Amer. Mach./Metalwork. Mfg.
American Machinist/Metalworking Manufacturing *(U. S.)*
Anal. Lett.
Analytical Letters *(U. S.)*
Ann. Acad. Sci. Fenn., Ser. A IV
Annales Academiae Scientiarum Fennicae, Series A IV *(Finland)*
Ann. Bot. Fenn.
Annales Botanici Fennici *(Finland)*
Ann. Dent.
Annals of Dentistry *(U. S.)*
Ann. Ponts Chaussees
Annales des Ponts et Chaussees *(France)*
Annu. ISA (Instrum. Soc. Amer.) Conf. Proc.
Annual ISA (Instrument Society of America) Conference Proceedings *(U. S.)*
Ann. Univ. Mariae Curie-Sklodowska, Lublin-Pol., Sect. DD
*Annales Universitatis Mariae Curie-Sklodowska, Lublin-Polonia, Sectio DD *(Poland)*
Ann. Univ. Sci. Budapest. Rolando Eotvos Nominatae, Sect. Geol.
*Annales Universitatis Scientiarum Budapestinensis de Rolando Eotvos Nominatae, Sectio Geologica *(Hungary)*
Annu. Rep. Res. Inst. Environ. Med., Nagoya Univ.
Annual Report of the Research Institute of Environmental Medicine, Nagoya University *(Japan)*
Annu. Rev. Genet.
Annual Review of Genetics *(U.S.)*
An. Univ. Bucuresti, Ser. Stiint. Natur., Fiz.
Analele Universitatii Bucuresti, Seria Stiintele Naturii, Fizica *(Romania)*
Apicultura (Bucharest)
Apicultura (Bucharest) *(Romania)*
Arbeitsgemeinsch. Forsch. Landes Nordrhein-Westfalen
Arbeitsgemeinschaft fuer Forschung des Landes Nordrhein-Westfalen *(West Germany)*
Arbeitsmed.-Sozialmed.-Arbeitshyg.
Arbeitsmedizin-Sozialmedizin-Arbeitshygiene *(West Germany)*
Arch. Jap. Chir.
Archiv fuer Japanische Chirurgie
see Nippon Geka Hokan
Arch. Mineral.
Archiwum Mineralogiczne *(Poland)*
Arch. Neer. Sci. Exactes Natur.
Archives Neerlandaises des Sciences Exactes et Naturelles *(Netherlands)*
Arch. Stomatol.
Archivio Stomatologico *(Italy)*
Ark. Zool.
Arkiv for Zoologi, Utgivet av Kungl. Svenska

Vetenskapsakademien *(Sweden)*
ASM (Amer. Soc. Metals), Trans. Quart.
*ASM (American Society for Metals), Transactions Quarterly (formerly Transactions of the American Society for Metals) *(U. S.)*
Astrofizika
Astrofizika *(Armenian S.S.R.)*
Astron. Tsirk.
Astronomicheskii Tsirkulyar *(U.S.S.R.)*
Astrophys. Lett.
*Astrophysical Letters *(Scotland)*
Astrophys. Space Sci.
*Astrophysics and Space Science *(Netherlands)*
At. Absorption Newslett.
Atomic Absorption Newsletter *(U. S.)*
At. Energy (China)
Atomic Energy (China)
see Yuan Tzu Neng
At. Energy Law J.
Atomic Energy Law Journal *(U. S.)*
Atmos. Environ.
*Atmospheric Environment *(England)*
Aust. J. Mar. Freshwater Res.
Australian Journal of Marine and Freshwater Research *(Australia)*
Aust. J. Zool.
Australian Journal of Zoology *(Australia)*
Aust. Mach. Prod. Eng.
Australian Machinery and Production Engineering *(Australia)*
Australas. Mfr.
Australasian Manufacturer *(Australia)*
Automat. Electron.
Automatica si Electronica *(Romania)*
Aviat. Week Space Technol.
Aviation Week and Space Technology *(U. S.)*
Bautechnik
Bautechnik, Die *(West Germany)*
Ber. Deut. Ges. Geol. Wiss., Reihe B
Berichte der Deutschen Gesellschaft fuer Geologische Wissenschaften, Reihe B. Mineralogie und Lagerstaettenforschung *(East Germany)*
Berg- Huettenmaenn. Monatsh. Montan. Hochsch. Leoben
Berg- und Huettenmaennische Monatschefte der Montanistischen Hochschule in Leoben *(West Germany)*
Berlin. Wetterkarte, Suppl.
Berliner Wetterkarte, Supplement *(West Germany)*
Beton Zhelezobeton
Beton i Zhelezobeton *(Georgian S.S.R.)*
Biol. Rundsch.
Biologische Rundschau *(East Germany)*
Blech
Blech *(West Germany)*
BNX Rev.
BNX Review *(England)*
Bodenkultur
Bodenkultur, Die *(Austria)*
Boll. Zool.
Bollettino di Zoologia. Pubblicato dall'Unione Zoologica Italiana *(Italy)*
Bol. Univ. Fed. Parana, Fis. Teor.
*Boletim da Universidade Federal do Parana, Fisica Teorica *(Brazil)*
Brain Res.
Brain Research *(Netherlands)*
Brit. Food J.
British Food Journal *(England)*
Brit. J. Plast. Surg.
British Journal of Plastic Surgery *(Scotland)*
Brit. Mycol. Soc. Trans.
British Mycological Society Transactions, The *(England)*
Brit. Plast.
British Plastics *(England)*
Build. Eng.
Building Engineering
see Kenchiku Gijutsu
Bull. Astron.
Bulletin Astronomique *(France)*
Bull. Astron. Inst. Neth., Suppl. Ser.
Bulletin of the Astronomical Institutes of the Netherlands, Supplement Series *(Netherlands)*
Bull. Belgicatom
Bulletin Belgicatom (formerly Belgicatom, Association Belge pour le Developpement Paficique de l'Energie Atomique, Bulletin d'Information) *(Belgium)*
Bull. Belg. Phys. Soc.
Bulletin of the Belgian Physical Society (formerly Bulletin de la Societe Belge de Physique) *(Belgium)*
Bull. Calcutta Math. Soc.
Bulletin of the Calcutta Mathematical Society *(India)*
Bull. Dir. Etud. Rech.
Bulletin de la Direction des Etudes et Recherches *(France)*
Bull. Earthquake Res. Inst., Univ. Tokyo
Bulletin of the Earthquake Research Inst., University of Tokyo
see Tokyo Daigaku Jishin Kenkyusho Iho
Bull. Eidgenoess. Gesundh., Beil. B
Bulletin des Eidgenoessisches Gesundheitsamtes, Beilage B *(Switzerland)*
Bull. Entomol. Res.
Bulletin of Entomological Research *(England)*
Bull. Fac. Eng., Hiroshima Univ.
Bulletin of the Faculty of Engineering, Hiroshima University
see Hiroshima Daigaku Kogakubu Kenkyu Hokoku
Bull. Fac. Sci. Eng., Chuo Univ.
Bulletin of the Faculty of Science and Engineering, Chuo University
see Chuo Daigaku Rikogakubu Kiyo
Bull. Geophys. Observ., Haile Sellassie I Univ.
Bulletin of the Geophysical Observatory, Haile Sellassie I University *(Ethopia)*
Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.), Suppl.
*Bulletin d'Information A.T.E.N. (Association Technique pour l'Energie Nucleaire), Supplement *(France)*
Bull. Inst. Geophys., Nat. Cent. Univ.
*Bulletin of the Institute of Geophysics, National Central University *(China (Taiwan))*
Bull. Inst. Int. Froid, Annexe
Bulletin de l'Institut International du Froid, Annexe *(France)*
Bull. Inst. Nat. Sante Rech. Med.
Bulletin de l'Institut National de la Sante et de la Recherche Medicale *(France)*
Bull. Inst. Space Aeronaut. Sci., Univ. Tokyo
Bulletin of the Institute of Space and Aeronautical Science, University of Tokyo
see Tokyo Daigaku Uchu Koku Kenkyusho Hokoku
Bull Int. Inst. Refrig., Suppl.
Bulletin of the International Institute of Refrigeration, Supplement
see Bull. Inst. Int. Froid, Annexe
Bull. Kyoto Educ. Univ., Ser. B
Bulletin of the Kyoto Educational University, Series B. Mathematics and Natural Science *(Japan)*
Bull. Office Int. Epizoot.
Bulletin de l'Office International des Epizooties *(France)*
Bull. Res. Inst. Miner. Dressing Met., Tohoku Univ.
Bulletin of the Research Inst. of Mineral Dressing and Metallurgy, Tohoku University
see Tohoku Daigaku Senko Seiren Kenkyusho Iho
Bull. Soc. Roy. Bot. Belg.
Bulletin de la Societe Royale de Botanique de Belgique *(Belgium)*
Bull. Soc. Sea Water Sci., Jap.
Bulletin of the Society of Sea Water Science, Japan
see Nippon Kaisui Gakkaishi
Bull. Tulane Univ. Med. Fac.
Bulletin of the Tulane University Medical Faculty *(U.S.)*
Bull. Volcanol.
Bulletin Volcanologique *(Italy)*
Bul. Stiint. Teh. Inst. Politeh. Timisoara
Buletinul Stiintific si Tehnic al Institutului Politehnic Timisoara *(Romania)*
Bus. Syst. Equip.
Business Systems and Equipment *(England)*
Bus. Week
Business Week *(U. S.)*
Byggmesteren
Byggmesteren (Norges Byggforskningsinstitutt) *(Norway)*
Byull. Inst. Teor. Astron.
Byulleten Instituta Teoreticheskoi Astronomii *(U.S.S.R.)*
Byull. Kom. Opred. Absol. Geol. Form.
Byulleten Komissii po Opredeleniyu Absolyutnogo Vozrasta Geologicheskikh Formatsii *(U.S.S.R.)*
CA–Cancer J. Clin.
CA– Cancer Journal Clinicians *(U.S.)*
Cah. Ing. Agron.
Cahiers des Ingenieurs Agronomes *(France)*
Cah. Oceanogr.
Cahiers Oceanographiques *(France)*
Calcified Tissue Res.
Calcified Tissue Research *(West Germany)*
Can. J. Ophthalmol.
Canadian Journal of Ophthalmology *(Canada)*

Can. J. Psychol.
Canadian Journal of Psychology *(Canada)*
Can. Mach. Metalwork.
Canadian Machinery and Metalworking *(Canada)*
Canner/Packer
Canner/Packer *(U. S.)*
Can. Nurse
Canadian Nurse *(Canada)*
Celul. Hirtie
*Celuloza si Hirtie *(Romania)*
Cercet. Met.
Cercetari Metalurgice *(Romania)*
Chartered Mech. Eng.
Chartered Mechanical Engineer *(England)*
Chem. Process. (London)
Chemical Processing (London) *(England)*
Chesapeake Sci.
Chesapeake Science *(U. S.)*
Chim. Ind., Genie Chim.
Chimie et Industrie, Genie Chimique (formed by the merger of Chimie et Industrie (Paris) and Genie Chimique (Paris)) *(France)*
Chin. Anim. Husb. Vet. Med.
Chinese Animal Husbandry and Veterinary Medicine
see Chung Kuo Hsu Mu Shou I
Chin. J. Dermatol.
Chinese Journal of Dermatology
see Chung Hua P'i Fu K'o Tsa Chih
Chin. J. Gynecol. Obstet.
Chinese Journal of Gynecology and Obstetrics
see Chung Hua Fu Ch'an K'o Tsa Chih
Chin. J. Phys. (Peking) (Engl. Transl.)
*Chinese Journal of Physics (Peking) (English Translation of Acta Physica Sinica (Wu Li Hsueh Pao)) *(U. S.)*
Chin. J. Surg.
Chinese Journal of Surgery
see Chung Hua Wai K'o Tsa Chih
Chung Hua Fu Ch'an K'o Tsa Chih
Chung Hua Fu Ch'an K'o Tsa Chih (Chinese Journal of Gynecology and Obstetrics) *(China)*
Chung Hua I Hsueh Tsa Chih
Chung Hua I Hsueh Tsa Chih (National Medical Journal of China) *(China)*
Chung Hua P'i Fu K'o Tsa Chih
Chung Hua P'i Fu K'o Tsa Chih (Chinese Journal of Dermatology) *(China)*
Chung Hua Wai K'o Tsa Chih
Chung Hua Wai K'o Tsa Chih (Chinese Journal of Surgery) *(China)*
Chung Kuo Hsu Mu Shou I
Chung Kuo Hsu Mu Shou I (Chinese Animal Husbandry and Veterinary Medicine) *(China)*
Chuo Daigaku Rikogakubu Kiyo
Chuo Daigaku Rikogakubu Kiyo (Bulletin of the Faculty of Science and Engineering, Chuo University) *(Japan)*
Civil Eng. (N. Y.)
Civil Engineering (New York) *(U. S.)*
Clay Sci. (Tokyo)
Clay Science (Tokyo) *(Japan)*
Coal Age
Coal Age *(U. S.)*
Cobalt
Cobalt *(France)*
Colloid J. (USSR) (Engl. Transl.)
Colloid Journal (USSR) (English Translation of Kolloidnyi Zhurnal) *(U. S.)*
Colloq. Int. Cent. Nat. Rech. Sci.
Colloques Internationaux du Centre National de la Recherche Scientifique *(France)*
Combustion
Combustion *(U.S.)*
Commer. Fish. Rev.
Commercial Fisheries Review *(U. S.)*
Commun. Math. Phys.
Communications in Mathematical Physics *(West Germany)*
Compt. Rend. Soc. Geol. Fr.
Compte Rendu Sommaire des Seances de la Societe Geologique de France *(France)*
Comput. Biomed. Res.
Computers and Biomedical Research *(U. S.)*
Concrete J.
Concrete Journal
see Konkurito Janaru
Constr. Masini
Constructia de Masini *(Romania)*
Coord. Chem. Rev.
Coordination Chemistry Reviews *(Netherlands)*
Corros. Prev. Contr.
Corrosion Prevention and Control *(England)*
Cuivre, Laitons, Alliages
Cuivre, Laitons, Alliages *(France)*
Curr. Awareness Bull.
Current Awareness Bulletin *(U. S.)*
Curr. Mod. Biol.
Currents in Modern Biology *(Netherlands)*
Czas. Stomatol.
Czasopismo Stomatologiczne *(Poland)*
Dan. Med. Bull.
Danish Medical Bulletin *(Denmark)*
Denki Shikenjo Kenkyu Hokoku
Denki Shikenjo Kenkyu Hokoku (Researches of the Electrotechnical Laboratory) *(Japan)*
Desalination
Desalination *(Netherlands)*
Deut. Hydrogr. Z.
Deutsche Hydrographische Zeitschrift *(West Germany)*
Deut. Zahn-, Mund- Kieferheilk.
Deutsche Zahn-, Mund- und Kieferheilkunde mit Zentralblatt fuer die Gesamte Zahn-, Mund- und Kieferheilkunde *(East Germany)*
Diffus. Data
*Diffusion Data *(U. S.)*
DMIC Rev.
DMIC Review of Recent Developments *(U. S.)*
Doboku Gijutsu
Doboku Gijutsu (Civil Engineering) *(Japan)*
Doc-Air-Espace
*Doc-Air-Espace *(France)*
Dokl.—Bot. Sci. Sect. (Engl. Transl.)
Doklady—Botanical Sciences Sections (English Translation) *(U.S.)*
Earth-Sci. Rev.
Earth-Science Reviews *(Netherlands)*
Eiyo To Shokuryo
Eiyo To Shokuryo (Journal of Japanese Society of Food and Nutrition) *(Japan)*
Ekon. Samf. Tidskr.
Ekonomiska Samfundets Tidskrift *(Sweden)*
Electron. Equip. News
Electronic Equipment News *(England)*
Electron. Ind. (Paris).
Electronique Industrielle (Paris) *(France)*
Electron. Packag. Prod.
Electronic Packaging and Production *(U. S.)*
Electrotechniek
Electrotechniek *(Netherlands)*
Elec. World
Electrical World *(U. S.)*
Elec. World (Shanghai)
Electrical World (Shanghai)
see Tien Shih Chieh
Elektromedizin
Elektromedizin und Ihre Grezgebiete *(Germany)*
Elektron. Bol'shikh Moshch.
Elektronika Bol'shikh Moshchnostei *(U.S.S.R.)*
Elektron. Obrab. Mater.
Elektronnaya Obrabotka Materialov *(Moldavian S.S.R.)*
Elektron. Rechenanlagen
Elektronische Rechenanlagen *(West Germany)*
Elektrotech. Cas.
Elektrotechnicky Casopis *(Czechoslovakia)*
Elektrotekhnika
Elektrotekhnika *(U.S.S.R.)*
Elektr. Sta.
Elektricheskie Stantsii *(U.S.S.R.)*
Engei Gakkai Zasshi
Engei Gakkai Zasshi (Journal of the Japanese Society for Horticultural Science) *(Japan)*
Engl. Elec. J.
English Electric Journal *(England)*
Entropie
Entropie *(France)*
Environ. Res.
Environmental Research *(U. S.)*
EPE, Rev. Energ. Primaire
EPE, Revue Energie Primaire
see Rev. Energ. Primaire
Ergonomics
Ergonomics *(England)*
Euratom Rev.
*Euratom Review of the European Atomic Energy Community (formerly Euratom Bulletin) *(Belgium)*

Exp. Pathol.
Experimentelle Pathologie *(East Germany)*
Farm, Ranch, Home Quart.
Farm, Ranch and Home Quarterly *(U. S.)*
FDA (Food Drug Admin.) Pap.
FDA (Food and Drug Administration) Papers *(U. S.)*
Fiz. Chastits Vys. Energ., Akad. Nauk Gruz. SSSR, Inst. Fiz.
Fizika Chastits Vysokikh Energii, Akademiya Nauk Gruzinskoi SSR, Institut Fiziki *(Georgian S.S.R.)*
Fiziol. Norm. Patol. (Bucharest)
Fiziologia Normala si Patologica (Bucharest) *(Romania)*
Fiz. Khim. Obrab. Mater.
Fizika i Khimiya Obrabotki Materialov *(U.S.S.R.)*
Fiz. Tekh. Poluprov.
*Fizika i Tekhnika Poluprovodnikov *(U.S.S.R.)*
Flame Notes, Beckman
Flame Notes, Beckman *(U. S.)*
FOA (Forsvarets Forsk.) Rep.
*FOA (Forsvarets Forskningsanstalt) Reports *(Sweden)*
Folia Haematol. (Leipzig)
Folia Haematologia (Leipzig) *(East Germany)*
Folia Med. Cracov.
Folia Medica Cracoviensia *(Poland)*
Food Eng. (Philadelphia)
Food Engineering (Philadelphia) (formerly Food Industries) *(U. S.)*
Forest. Abstr.
Forestry Abstracts *(England)*
Forsch. Ingenieurw.
Forschung im Ingenieurwesen *(West Germany)*
Fortschr. Hochpolym.-Forsch.
Fortschritte der Hochpolymeren-Forschung *(West Germany)*
Fortschr. Zool.
Fortschritte de Zoologie *(West Germany)*
Foundry
Foundry *(U. S.)*
Freiberg. Forschungsh., B
Freiberger Forschungshefte, Reihe B *(East Germany)*
Fukuoka Acta Med.
Fukuoka Acta Medica
see Fukuoka Igaku Zasshi
Fukuoka Igaku Zasshi
Fukuoka Igaku Zasshi (Fukuoka Acta Medica) *(Japan)*
Fukushima Daigaku Gakugei Gakubu Rika Hokoku
Fukushima Daigaku Gakugei Gakubu Rika Hokoku (The Science Reports of the Faculty of Arts and Science, Fukushima University) *(Japan)*
Genet. Pol.
*Genetica Polonica *(Poland)*
Geofiz. Byull.
Geofizicheskii Byulleten *(U.S.S.R.)*
Geofys. Sb.
Geofysikalni Sbornik *(Czechoslovakia)*
Geol. Geofiz.
Geologiya i Geofizika *(U.S.S.R.)*
Geol. Nefti Gaza
Geologiya Nefti i Gaza† *(U.S.S.R.)*
Geol. Soc. Amer., Spec. Pap.
Geological Society of America, Special Paper *(U. S.)*
Geophys. Geol. (Leipzig)
Geophysik und Geologie (Leipzig) *(East Germany)*
Gidroaeromekhanika
Gidroaeromekhanika *(Ukrainian S.S.R.)*
Giesserei
Giesserei *(West Germany)*
Glas-Instrum.-Tech.
Glas-Instrumenten-Technik *(West Germany)*
Glass Ceram. (USSR) (Engl. Transl.)
Glass and Ceramics (USSR) (English Translation of Steklo i Keramika) *(U. S.)*
Gorn. Zh.
Gornyi Zhurnal *(U.S.S.R.)*
Grinding Finish.
Grinding and Finishing *(U. S.)*
Haematologia (Budapest)
Haematologia (Budapest) *(Hungary)*
Haiken Gijutsu
Haikan Gijutsu (The Piping Engineering) *(Japan)*
Handb. Med. Radiol.
Handbuch der Medizinschen Radiologie *(West Germany)*
Harper Hosp. Bull.
Harper Hospital Bulletin *(U. S.)*
Health Lab. Sci.
Health Laboratory Science *(U. S.)*
Heidelberg. Akad. Wiss. Math.-Naturwiss. Kl., Sitzungsber.
Heidelberger Akademie der Wissenschaften. Mathematisch-Naturwissenschaftliche Klasse, Sitzungsberichte *(West Germany)*
Hemel Dampkring
Hemel en Dampkring *(Belgium)*
Hiroshima Daigaku Kogakubu Kenkyu Hokoku
Hiroshima Daigaku Kogakubu Kenkyu Hokoku (Bulletin of the Faculty of Engineering, Hiroshima University) *(Japan)*
Hoken Butsuri
Hoken Butsuri (Journal of Japan Health Physics Society) *(Japan)*
Hokkaidoritsu Eisei Kenkyushoho
Hokkaidoritsu Eisei Kenkyushoho (Report of the Hokkaido Inst. of Public Health) *(Japan)*
Hokuno
Hokuno (Agriculture in Hokkaido) *(Japan)*
Honvedorvos
Honvedorvos *(Hungary)*
Hyg. Sanit. (USSR) (Engl. Transl.)
Hygiene and Sanitation (USSR) (English Translation of Gigiena i Sanitariya) *(U. S.)*
Hyogo Noka Daigaku Kiyo
Hyogo Noka Daigaku Kiyo (Memoirs of the Hyogo University of Agriculture) *(Japan)*
Idengaku Zasshi, Suppl.
Idengaku Zasshi, Supplement (Japanese Journal of Genetics, Supplement) *(Japan)*
IEEE (Inst. Elec. Electron. Eng.) Trans. Audio Electroacoust.
*IEEE (Institute of Electrical and Electronics Engineers) Transactions on Audio and Electroacoustics *(U.S.)*
Ig. Sanita Pubblica
Igiene e Sanita Pubblica *(Italy)*
Ind.-Anz.
Industrie-Anzeiger *(West Germany)*
Ind.-Elektron. Forsch. Fertigung
Industrie-Elektronik in Forschung und Fertigung *(West Germany)*
Indian J. Agr. Sci.
Indian Journal of Agricultural Science, The *(India)*
Indian J. Appl. Chem.
Indian Journal of Applied Chemistry *(India)*
Indian J. Cancer
Indian Journal of Cancer *(India)*
Indian J. Occup. Health
Indian Journal of Occupational Health *(India)*
Indian Pediat.
Indian Pediatrics *(India)*
Ind. Mineraria
Industria Mineraria *(Italy)*
Ind. Water Eng.
Industrial Water Engineering *(U. S.)*
Inform. Byull. Sov. Antarkt. Eksped.
Informatsionnyi Byulleten Sovetskoi Antarkticheskoi Ekspeditsii *(U.S.S.R.)*
Ing. Bygningsv., Ugeovers.
Ingenieor- og Bygningsvaesen, Ugeoversigt *(Denmark)*
Inst. Mining Met., Trans./Sect. B
Institution of Mining and Metallurgy, Transactions/Section B. Applied Earth Science (continues in part Transactions of the Institution of Mining and Metallurgy) *(England)*
Inst. Petrol. Rev.
Institute of Petroleum Review, The *(England)*
Instrum. Contr. Eng.
Instrument and Control Engineering *(England)*
Instrum. Med.
Instrumentation in Medicine *(England)*
Int. Ass. Sci. Hydrol., Bull.
International Association of Scientific Hydrology, Bulletin *(Belgium)*
Int. Chem. Eng.
*International Chemical Engineering. A Quarterly Journal of Translations from Russia, Eastern Europe, and Asia *(U. S.)*
Int. J. Neurol.
International Journal of Neurology *(U. S.)*
Int. Rev. Gesam. Hydrobiol.
Internationale Revue der Gesamten Hydrobiologie *(East Germany)*
Int. Surg.
International Surgery *(U. S.)*
Inzh. Zh., Mekh. Tverd. Tela
Inzhenernyi Zhurnal, Mekhanika Tverdogo Tela (formerly Inzhenernyi Zhurnal) *(U.S.S.R.)*
Iron Age Metalwork. Int.
Iron Age Metalworking International *(U. S.)*
ISA (Instrum. Soc. Amer.), Proc., Nat. Power Instrum. Symp.
ISA (Instrument Society of America), Proceedings, National Power Instrumentation Symposium *(U. S.)*

Issled. Genet.
Issledovaniya po Genetike *(U.S.S.R.)*

Issled. Primen. Tsifrovykh Analogovykh Vychisl. Mash. Yad. Fiz. Tekh., Sb. Statei (U.S.S.R.)
*Issledovanie Primenenii Tsifrovykh i Analogovykh Vychislitel'nykh Mashin v Yadernoi Fizike i Tekhnike, Moskovskii Inzhenerno-Fizicheskii Institut, Sbornik Statei *(U.S.S.R.)*

Izobret., Prom. Obraztsy, Tovarnye Znaki
Izobreteniya, Promyshlennye Obraztsy, Tovarnye Znaki *(U.S.S.R.)*

Izv. Akad. Nauk Arm. SSR, Biol. Nauki
Izvestiya Akademii Nauk Armyanskoi SSR, Biologicheskie Nauki (superseded by Biologicheskii Zhurnal Armenii) *(Armenian S.S.R.)*

Izv. Akad. Nauk Arm. SSR, Ser. Fiz.-Mat. Nauk
Izvestiya Akademii Nauk Armyanskoi SSR, Seriya Fiziko-Matematicheskikh Nauk *(Armenian S.S.R.)*

Izv. Akad. Nauk Arm. SSR, Ser. Tekh. Nauk
Izvestiya Akademii Nauk Armyanskoi SSR, Seriya Tekhnicheskikh Nauk *(Armenian S.S.R.)*

Izv. Akad. Nauk Kaz. SSR, Ser. Khim.
Izvestiya Akademii Nauk Kazakhskoi SSR, Seriya Khimicheskaya *(Kazakh S.S.R.)*

Izv. Akad. Nauk SSSR, Otd. Tekh. Nauk, Mekh. Mashinostr.
Izvestiya Akademii Nauk SSSR, Otdelenie Tekhnicheskikh Nauk, Mekhanika i Mashinostroenie *(U.S.S.R.)*

Izv. Akad. Nauk SSSR, Ser. Biol.
Izvestiya Akademii Nauk SSSR, Seriya Biologicheskaya *(U.S.S.R.)*

Izv. Akad. Nauk SSSR, Ser. Geol.
Izvestiya Akademii Nauk SSSR, Seriya Geologicheskaya *(U.S.S.R.)*

Izv. Akad. Nauk SSSR, Ser. Mat.
Izvestiya Akademii Nauk SSSR, Seriya Matematicheskaya *(U.S.S.R.)*

Izv. Akad. Nauk Tadzh. SSR, Otd. Fiz.-Tekh. Khim. Nauk
Izvestiya Akademii Nauk Tadzhikskoi SSR, Otdelenie Fiziko-Tekhnicheskikh i Khimicheskikh Nauk *(Tadzhik S.S.R.)*

Izv. Inst. Elektron., Bulg. Akad. Nauk.
Izvestiya na Instituta po Elektronika, Bulgarska Akademiya na Naukite *(Bulgaria)*

Izv. Inst. Khidrol. Meteorol., Bulg. Akad. Nauk.
Izvestiya na Instituta po Khidrologiya i Meteorologiya, Bulgarska Akademiya na Naukite, Otdelenie za Matematicheski i Fizicheski Nauki *(Bulgaria)*

Izv. Vyssh. Ucheb. Zaved., Mat.
*Izvestiya Vysshikh Uchebnykh Zavedenii, Matematika *(U.S.S.R.)*

Izv. Vyssh. Ucheb. Zaved., Priborostr.
Izvestiya Vysshikh Uchebnykh Zavedenii, Priborostroenie *(U.S.S.R.)*

Izv. Vyssh. Ucheb. Zaved., Tekhnol. Legk. Prom.
Izvestiya Vysshikh Uchebnykh Zavedenii, Tekhnologiya Legkoi Promyshlennosti *(Ukrainian S.S.R.)*

J. Amer. Podiat. Ass.
Journal of the American Podiatry Association *(U. S.)*

Jap. J. Dairy Sci.
Japanese Journal of Dairy Science (Japan)
see *Rakuno Kagaku no Kenkyu*

Jap. J. Exp. Morphol.
Japanese Journal of Experimental Morphology
see *Jikken Keitaigakushi*

Jap. J. Genet., Suppl.
Japanese Journal of Genetics, Supplement
see *Idengaku Zasshi, Suppl.*

Jap. J. Pharm. Chem.
Japanese Journal of Pharmacy and Chemistry
see *Yakugaku Kenkyu*

Jap. J. Zootech. Sci.
Japanese Journal of Zootechnical Science
see *Nippon Chikusangaku Kaiho*

JARE Sci. Rep., Spec. Issue
JARE Scientific Reports, Special Issue *(Japan)*

J. Ass. Phys. Ment. Rehabil.
Journal of the Association for Physical and Mental Rehabilitation *(U. S.)*

J. Aust. Ceram. Soc.
Journal of the Australian Ceramic Society *(Australia)*

J. Balneol. Soc. Jap.
Journal of the Balneological Society of Japan
see *Onsen Kagaku*

J. Belge Radiol., Monogr.
*Journal Belge de Radiologie, Monographie *(Belgium)*

J. Biol. Photogr. Ass.
Journal of the Biological Photographic Association, The *(U. S.)*

J. Brit. Ceram. Soc.
Journal of the British Ceramic Society, The *(England)*

J. Cell Sci.
*Journal of Cell Science *(England)*

J. Cryst. Growth
Journal of Crystal Growth *(Netherlands)*

J. Egypt. Public Health Ass.
Journal of the Egyptian Public Health Association *(Egypt)*

Jemna Mech. Opt.
Jemna Mechanika a Optika *(Czechoslovakia)*

Jeune Sci.
Jeune Scientifique *(Canada)*

J. Food Sci. Technol.
Journal of Food Science and Technology
see *Nippon Shokuhin Kogyo Gakkaishi*

J. Forensic Med.
Journal of Forensic Medicine *(South Africa)*

J. Formosan Med. Ass.
Journal of the Formosan Medical Association
see *T'ai-wan I Hsueh Hui Tsa Chih*

J. Fuel Heat. Technol.
Journal of Fuel and Heating Technology *(England)*

J. Geol.
Journal of Geology *(U. S.)*

Jibiinkoka Rinsho
Jibiinkoka Rinsho (Oto-Rhino-Laryngological Clinic) *(Japan)*

Jikken Keitaigakushi
Jikken Keitaigakushi (Japanese Journal of Experimental Morphology) *(Japan)*

J. Indian Soc. Soil Sci.
Journal of the Indian Society of Soil Science *(India)*

J. Inst. Safety High Pressure Gas Eng.
Journal of the Inst. of Safety of High Pressure Gas Engineering
see *Koatsu Gasu*

J. Inst. Telecommun. Eng.
Journal of the Institution of Telecommunication Engineers *(India)*

J. Irrig. Drain. Div., Amer. Soc. Civil Eng.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers *(U. S.)*

J. Jap. Health Phys. Soc.
Journal of Japan Health Physics Society
see *Hoken Butsuri*

J. Jap. Med. Ass.
Journal of the Japan Medical Association, The
see *Nippon Ishikai Zasshi*

J. Jap. Petrol. Inst.
Journal of the Japan Petroleum Institute
see *Sekiyu Gakkaishi*

J. Jap. Soc. Food Nutr.
Journal of Japanese Society of Food and Nutrition
see *Eiyo To Shokuryo*

J. Jap. Soc. Hort. Sci.
Journal of the Japanese Society for Horticultural Science
see *Engei Gakkai Zasshi*

J. Jap. Stomatol. Soc.
Journal of the Japan Stomatological Society, The
see *Kokubyo Gakkai Zasshi*

J. Jap. Tech. Ass. Pulp Pap. Ind.
Journal of the Japanese Technical Association of Pulp and Paper Industry
see Kami Pa Gikyoshi

J. Jap. Wood Res. Soc.
Journal of the Japan Wood Research Society
see *Mokuzai Gakkaishi*

J. Karnatak Univ.
Journal of the Karnatak University *(India)*

J. Macromol. Sci., Part A
Journal of Macromolecular Science, Part A. Chemistry (supersedes Journal of Macromolecular Chemistry) *(U. S.)*

J. Marine Res.
Journal of Marine Research (Sears Foundation for Marine Research) *(U.S.)*

J. Metal Finish. Soc. Jap.
Journal of the Metal Finishing Society of Japan, The
see *Kinzoku Hyomen Gijutsu*

J. Nagasaki Med. Ass., Suppl.
Journal of the Nagasaki Medical Association, Supplement
see *Nagasaki Igakkai Zasshi, Suppl.*

J. Nucl. Med., Suppl.
*Journal of Nuclear Medicine, Supplement *(U.S.)*

J. Nucl. Sci. (Seoul)
*Journal of Nuclear Sciences (Seoul) (Wonjaryogwon. Yon'gu Nonmun Chip) *(South Korea)*

J. Osaka Univ. Dent. Soc.

Journal of the Osaka University Dental Society, The
see Osaka Daigaku Shigaku Zasshi

J. Paleontol.
Journal of Paleontology *(U.S.)*

J. Phys., A (London)
*Journal of Physics, A (London), Proceedings of the Physical Society (General) (supersedes in part Proceedings of the Physical Society (London)) *(England)*

J. Phys., B (London)
*Journal of Physics, B (London), Proceedings of the Physical Society (Atomic and Molecular Physics) (supersedes in part Proceedings of the Physical Society (London)) *(England)*

J. Phys., C (London)
*Journal of Physics, C (London), Proceedings of the Physical Society (Solid State Physics) (supersedes in part Proceedings of the Physical Society (London)) *(England)*

J. Phys., E (London)
*Journal of Physics, E (London) (supersedes Journal of Scientific Instruments) *(England)*

J. Phys. Chem. Solids, Suppl.
*Journal of Physics and Chemistry of Solids, Supplement *(England)*

J. Phys. Soc. Jap., Suppl.
*Journal of the Physical Society of Japan, Supplement *(Japan)*

J. Radioanal. Chem.
*Journal of Radioanalytical Chemistry *(Netherlands–Hungary)*

J. Radiol. Phys. Ther., Univ. Kanazawa
Journal of Radiology and Physical Therapy, University of Kanazawa, The
see Kanazawa Irigaku Sosho

J. Roy. Army Med. Corps
Journal of the Royal Army Medical Corps *(England)*

J. Sediment. Petrol.
Journal of Sedimentary Petrology *(U. S.)*

J. Soc. Eng. Miner. Springs, Jap.
Journal of the Society of Engineers for Mineral Springs, Japan
see Onsen Kogakkaishi

J. Soc. Fiber Sci. Technol., Jap.
Journal of the Society of Fiber Science and Technology, Japan
see Sen'i Gakkaishi

J. Soc. Instrum. Contr. Eng.
Journal of the Society of Instrument and Control Engineers
see Keisoku To Seigyo

J. Soc. Leather Trades Chem.
Journal of the Society of Leather Trades Chemists *(England)*

J. Soc. Rubber Ind., Jap.
Journal of the Society of Rubber Industry, Japan
see Nippon Gomu Kyokaishi

J. Tokyo Women's Med. Coll.
Journal of Tokyo Women's Medical College
see Tokyo Joshi Ika Daigaku Zasshi

Jugoslov. Pronalazastvo
Jugoslovensko Pronalazastvo *(Yugoslavia)*

Kagaku Keisatsu Kenkyusho Hokoku
Kagaku Keisatsu Kenkyusho Hokoku (Reports of the National Research Inst. of Police Science) *(Japan)*

Kagoshima Daigaku Suisangakubu Kiyo
Kagoshima Daigaku Suisangakubu Kiyo (Memoirs of the Faculty of Fisheries, Kagoshima University) *(Japan)*

Kaibogaku Zasshi
Kaibogaku Zasshi (Acta Anatomica Nipponica) *(Japan)*

Kali Steinsalz
Kali und Steinsalz *(West Germany)*

Kami Pa Gikyoshi
Kami Pa Gikyoshi (Journal of the Japanese Technical Association of Pulp and Paper Industry) *(Japan)*

Kanazawa Irigaku Sosho
Kanazawa Irigaku Sosho (Journal of Radiology and Physical Therapy, University of Kanazawa, The) *(Japan)*

Keisoku To Seigyo
Keisoku To Seigyo (Journal of the Society of Instrument and Control Engineers) *(Japan)*

Kenchiku Gijutsu
Kenchiku Gijutsu (Building Engineering) *(Japan)*

Kinzoku Hyomen Gijutsu
Kinzoku Hyomen Gijutsu (The Journal of the Metal Finishing Society of Japan) *(Japan)*

Kleinheubacher Ber.
Kleinheubacher Berichte *(East Germany)*

Klin. Monatsbl. Augenheilk.
Klinische Monatsblaetter fuer Augenheilkunde und fuer Augenaerztliche Fortbildung *(West Germany)*

Koatsu Gasu
Koatsu Gasu (Journal of the Inst. of Safety of High Pressure Gas Engineering) *(Japan)*

Kobe Kogyo Giho
Kobe Kogyo Giho (Kobe Kogyo Technical Report) *(Japan)*

Kobe Kogyo Tech. Rep.
Kobe Kogyo Technical Report
see Kobe Kogyo Giho

K'o Hsueh Ta Chung
K'o Hsueh Ta Chung (Popular Science) *(China)*

Kokubyo Gakkai Zasshi
Kokubyo Gakkai Zasshi (Journal of the Japan Stomatological Society, The) *(Japan)*

Konkurito Janaru
Konkurito Janaru (Concrete Journal) *(Japan)*

Konserv. Ovoshchesush. Prom.
Konservnaya i Ovoshchesushil'naya Promyshlennost *(U.S.S.R.)*

Korroz. Metal. Splavov
Korroziya Metallov i Splavo *(U.S.S.R.)*

Kosm. Biol. Med.
Kosmicheskaya Biologiya i Meditsina *(U.S.S.R.)*

Kosm. Luchi
Kosmicheskie Luchi *(U.S.S.R.)*

Kovove Mater.
Kovove Materialy *(Czechoslovakia)*

Kowan Giken Shiryo
Kowan Giken Shiryo (Technical Note of Port and Harbour Technical Research Inst., Ministry of Transportation, Japan) *(Japan)*

Krist. Tech.
Kritstall und Technik *(East Germany)*

Kuki Seijo
Kuki Seijo (Air Cleaning) *(Japan)*

Kumamoto Daigaku Kogakubu Kenkyu Hokoku
Kumamoto Daigaku Kogakubu Kenkyu Hokoku (Technical Report of the Kumamoto University) *(Japan)*

Kumamoto Daigaku Kyoikugakubu Kiyo
Kumamoto Daigaku Kyoikugakubu Kiyo (Memoirs of the Faculty of Education, Kumamoto University) *(Japan)*

Kurznachr. Akad. Wiss. Goettingen
Kurznachrichten der Akademie der Wissenschaften in Goettingen *(West Germany)*

Kyoto Daigaku Kogyo Kyoin Yoseijo Kenkyu Hokoku
Kyoto Daigaku Kogyo Kyoin Yoseijo Kenkyu Hokoku (Report of the Training Inst. for Engineering Teachers, Kyoto University) *(Japan)*

Kyushu Daigaku Kogaku Shuho
Kyushu Daigaku Kogaku Shuho (Technology Reports of the Kyushu University) *(Japan)*

Kyushu Daigaku Seisan Kagaku Kenkyusho Hokoku
Kyushu Daigaku Seisan Kagaku Kenkyusho Hokoku (The Reports of the Research Inst. of Science and Industry, Kyushu University) *(Japan)*

Lakokrasoch. Mater. Ikh Primen.
Lakokrasochnye Materialy i Ikh Primenenie *(U.S.S.R.)*

Landbouwtijdschrift
Landbouwtijdschrift *(Belgium)*

Lasers Opt. Non Conv.
Lasers et Optique Non Conventionelle *(France)*

Lebensversicherungsmedizin
Lebensversicherungsmedizin *(West Germany)*

Light Metals
Light Metals (superseded by Light Metals and Metals Industry (London)) *(England)*

Light Metals Metal Ind. (London)
*Light Metals and Metal Industry (London) (formed by merger of Light Metals and The Metal Industry (London)) *(England)*

Lipids
Lipids *(U. S.)*

Liteinoe Proizvod.
Liteinoe Proizvodstvo *(U.S.S.R.)*

Lithos
Lithos *(Norway)*

Lutte Cancer
Lutte Contre le Cancer *(France)*

Machinery (N. Y.)
Machinery (New York) *(U. S.)*

Mach. Prod. Eng.
Machinery and Production Engineering *(England)*

Mach. Shop Eng. Mfg.
Machine Shop and Engineering Manufacture *(England)*

Mach. Tool Blue Book
Machine and Tool Blue Book *(U. S.)*

Mag. Stand.
Magazine of Standards *(U. S.)*

Magy. Traumatol., Orthop. Helyreallito Sebesz.
Magyar Traumatologia, Orthopaedia es Helyreallito Sebeszet *(Hungary)*

Manage. Sci.

Management Science *(U.S.)*
Mashinovedenie
Mashinovedenie *(U.S.S.R.)*
Mass Prod.
Mass Production *(England)*
Mater. Res. Bull.
Materials Research Bulletin *(U. S.)*
Mech. World Eng. Rec.
*Mechanical World and Engineering Record *(England)*
Med. Bull. U. S. Army, Eur.
Medical Bulletin of the U. S. Army, Europe *(U.S.)*
Med. Nucl.-Radiobiol. Lat., Suppl.
*Medicina Nucleare–Radiobiologica Latina, Suppl. *(Italy)*
Med. Radiol. (USSR) (Engl. Transl.)
Medical Radiology (USSR) (English Translation of Meditsinskaya Radiologiya) *(U. S.)*
Mekh. Polim.
Mekhanika Polimerov *(Latvian S.S.R.)*
Mekh. Razrusheniya Metal., Akad. Nauk Ukr. SSR, Respub. Mezhvedom. Sb.
Mekhanizm Razrusheniya Metallov, Akademiya Nauk Ukrainskoi SSR, Respublikanskii Mezhvedomstvennyi Sbornik *(Ukrainian S.S.R.)*
Mem. Fac. Educ., Kumamoto Univ.
Memoirs of the Faculty of Education, Kumamoto University
see Kumamoto Daigaku Kyoikugakubu Kiyo
Mem. Fac. Fish., Kagoshima Univ.
Memoirs of the Faculty of Fisheries, Kagoshima University
see Kagoshima Daigaku Suisangakubu Kiyo
Mem. Fac. Sci., Kyoto Univ., Ser. Biol.
Memoirs of the Faculty of Science, Kyoto University, Series of Biology (formerly Memoirs of the College of Science, University of Kyoto, Series B (Biology)) *(Japan)*
Mem. Fac. Sci., Kyoto Univ., Ser. Phys., Astrophys., Geophys., Chem.
Memoirs of the Faculty of Science, Kyoto University, Series of Physics, Astrophysics, Geophysics, and Chemistry (formerly Memoirs of the College of Science, University of Kyoto, Series A) *(Japan)*
Mem. Hyogo Univ. Agr.
Memoirs of the Hyogo University of Agriculture
see Hyogo Noka Daigaku Kiyo
Meres Automat.
Meres es Automatika *(Hungary)*
Mes., Regul., Automat.
Mesures, Regulation, Automatisme *(France)*
Messtechnik
*Messtechnik. Zeitschrift fuer Instrumentenkunde (supersedes Zeitschrift fuer Instrumentenkunde) *(West Germany)*
Metabolism
*Metabolism: Clinical and Experimental *(U. S.)*
Metal Finish.
Metal Finishing *(U. S.)*
Metallwirtschaft
Metallwirtschaft–Wissenschaft–Technik *(Germany)*
Metals (London)
Metals (London) *(England)*
Metals Abstr.
*Metals Abstracts (successor to Review of Metal Literature and Metallurgical Abstracts) *(U. S.-England)*
Metal Sci. Heat Treat. (USSR) (Engl. Transl.)
Metal Science and Heat Treatment (USSR) (English Translation of Metallovedenie i Termicheskaya Obrabotka Metallov) *(U. S.)*
Metal Treat.
Metal Treating *(U. S.)*
Met. Elec. (Madrid)
Metalurgia y Electricidad (Madrid) *(Spain)*
Meteoritika
Meteoritika *(U.S.S.R.)*
Method. Phys. Anal.
Methodes Physiques d'Analyse *(France)*
Met. Rev. (Publ. in Metals Mater.)
Metallurgical Reviews (Published in Metals and Materials) *(England)*
Met. Spec. (Paris)
Metallurgie Speciale (Paris) *(France)*
Microwaves
Microwaves *(U. S.)*
Mie Kaibo Gyosekishu
Mie Kaibo Gyosekishu *(Japan)*
Milk Dealer
Milk Dealer, The *(U. S.)*
Miner. Deposita
Mineralium Deposita *(West Germany)*
Minerva Med. Sicil.
*Minerva Medica Siciliana (continuation of Gazzetta Medice Siciliana) Supplemento a Minerva Medica *(Italy)*
Minerva Med., Suppl.
*Minerva Medica, Supplemento *(Italy)*
Mines Met.
Mines et Metallurgie *(France)*
Mining Met. Quart. (USSR) (Engl. Transl.), Suppl.
Mining and Metallurgy Quarterly, (USSR) (English Translation of Rudarsko-Metalurski Zbornik, Supplement) *(Yugoslavia)*
Mod. Packag.
Modern Packaging *(U. S.)*
Mod. Unfallverhuet.
Moderne Unfallverhuetung *(West Germany)*
Mokuzai Gakkaishi
Mokuzai Gakkaishi (Journal of the Japan Wood Research Society) *(Japan)*
Mol. Biol.
*Molekulyarnaya Biologiya *(U.S.S.R.)*
Mon. Corresp. Befoerd. Erd Himmelskunde
Monatliche Correspondenz zur Befoerderung der Erd und Himmelskunde *(East Germany)*
Monit. Zool. Ital., Suppl.
Monitore Zoologico Italiano, Supplemento *(Italy)*
Montes
Montes *(Spain)*
Motor Ship
Motor Ship *(England)*
Motortech. Z.
Motortechnische Zeitschrift *(West Germany)*
Muanyag Gumi
Muanyag es Gumi *(Hungary)*
Nachrichtentechnik
Nachrichtentechnik *(East Germany)*
Nagano Kogyo Koto Senmon Gakko Kiyo
Nagano Kogyo Koto Senmon Gakko Kiyo (Research Reports, Nagano Technical College) *(Japan)*
Nagasaki Igakkai Zasshi, Suppl.
Nagasaki Igakkai Zasshi, Supplement (Journal of the Nagasaki Medical Association, Supplement) *(Japan)*
Nan Ching Ta Hsueh Hsueh Pao, Tzu Jan K'o Hsueh
Nan Ching Ta Hsueh Hsueh Pao, Tzu Jan K'o Hsueh (Acta Universitatis Nankinensis Scientiarum Naturalium) *(China)*
Nat. Fire Codes
National Fire Codes *(U. S.)*
Nat. Med. J. China
National Medical Journal of China
see Chung Hua I Hsueh Tsa Chih
Nauch. Zap. Inst. Mashinoved. Avtomat., Akad. Nauk Ukr. SSR, Ser. Mashinoved.
Nauchnye Zapiski Instituta Mashinovedeniya i Avtomatiki, Akademiya Nauk Ukraninskoi SSR, Seriya Mashinovedeniya *(Ukrainian S.S.R.)*
Neftegazov. Geol. Geofiz.
Neftegazovaya Geologiya i Geofizika *(U.S.S.R.)*
Nerv. Sist., Leningrad. Gos. Univ., Fiziol. Inst.
Nervnaya Sistema, Leningradskii Gosudarstvennyi Universitet imeni A. A. Zhdanova, Fiziologicheskii Institut *(U.S.S.R.)*
Neth. J. Sea Res.
Netherlands Journal of Sea Research *(Netherlands)*
Neues Jahrb. Mineral., Monatsh.
Neues Jahrbuch fuer Mineralogie, Monatshefte *(West Germany)*
Newslett. Isotop. Generator Inform. Centre
*Newsletter of the Isotopic Generator Information Centre *(France)*
Nippon Byori Gakkai Kaishi
Nippon Byori Gakkai Kaishi (Transactiones Societatis Pathologicae Japonicae) *(Japan)*
Nippon Chikusangaku Kaiho
Nippon Chikusangaku Kaiho (Japanese Journal of Zootechnical Science) *(Japan)*
Nippon Geka Hokan
Nippon Geka Hokan (Archiv fuer Japanische Chirurgie) *(Japan)*
Nippon Gomu Kyokaishi
Nippon Gomu Kyokaishi (Journal of the Society of Rubber Industry, Japan) *(Japan)*
Nippon Ishikai Zasshi
Nippon Ishikai Zasshi (The Journal of the Japan Medical Association) *(Japan)*
Nippon Kaisui Gakkaishi
Nippon Kaisui Gakkaishi (Bulletin of the Society of Sea Water Science, Japan) *(Japan)*
Nippon Sakumotsu Gakkai Kiji
Nippon Sakumotsu Gakkai Kiji (Proceedings of the Crop Scienc Society of Japan) *(Japan)*
Nippon Shokuhin Kogyo Gakkaishi

Nippon Shokuhin Kogyo Gakkaishi (Journal of Food Science and Technology) *(Japan)*
Nisshin Seiko Giho
Nisshin Seiko Giho (Technical Report of Nisshin Steel Co., Ltd.) *(Japan)*
Norsk Skogind.
Norsk Skogindustri *(Norway)*
Nucl. Law Bull.
*Nuclear Law Bulletin *(Belgium)*
Nucl. Law Bull., Suppl.
*Nuclear Law Bulletin, Supplement *(Belgium)*
Nukleonika, Supl.
*Nukleonika, Suplement *(Poland)*
N. Z. Sci. Rev.
New Zealand Science Review *(New Zealand)*
Oceanogr. Mag.
Oceanographical Magazine, The *(Japan)*
Ochr. Pr.
Ochrona Pracy *(Poland)*
Odontol. Tidskr.
Odontologisk Tidskrift *(Sweden)*
Oftal'mol. Zh.
Oftal'mologicheskii Zhurnal *(Ukrainian S.S.R.)*
Okayama Daigaku Onsen Kenkyusho Hokoku
Okayama Daigaku Onsen Kenkyusho Hokoku (Papers of the Inst. for Thermal Spring Research, Okayama University) *(Japan)*
Oncol. Radiol.
Oncologia si Radiologia *(Romania)*
Onde Elec., Suppl.
*Onde Electrique, L, Supplement *(France)*
Onsen Kagaku
Onsen Kagaku (Journal of the Balneological Society of Japan) *(Japan)*
Onsen Kogakkaishi
Onsen Kogakkaishi (Journal of the Society of Engineers for Mineral Springs, Japan) *(Japan)*
Opt.-Mekh. Prom.
Optiko-Mekhanicheskaya Promyshlennost *(U.S.S.R.)*
Osaka Daigaku Shigaku Zasshi
Osaka Daigaku Shigaku Zasshi (The Journal of Osaka University Dental Society) *(Japan)*
Osaka Furitsu Kogyo Shoreikan Hokoku
Osaka Furitsu Kogyo Shoreikan Hokoku (Reports of Industrial Research Inst., Osaka Prefecture) *(Japan)*
Oto-Rhino-Laryngol. Clin.
Oto-Rhino-Laryngological Clinic
see *Jibiinkoka Rinsho*
Palaeogeogr., Paleoclimatol., Paleoecol.
Palaeogeography, Palaeoclimatology, Palaeoecology *(Netherlands)*
Paperi Puu-Lehdesta
Paperi ja Puu-Lehdesta *(Finland)*
Pap. Inst. Thermal Spring Res., Okayama Univ.
Papers of the Inst. for Thermal Spring Research, Okayama University
see *Okayama Daigaku Onsen Kenkyusho Hokoku*
Pediatrics, Suppl.
Pediatrics, Supplement *(U. S.)*
Pei Ching Ta Hsueh Hsueh Pao, Tzu Jan K'o Hsueh
Pei Ching Ta Hsueh Hsueh Pao, Tzu Jan K'o Hsueh (Acta Scientiarum Naturalium Universitatis Pekinensis) *(China)*
Petrol Gaze
*Petrol si Gaze *(Romania)*
Photogr. Appl. Sci. Technol.
*Photographic Applications in Science and Technology *(U. S.)*
Phys.-Diaet. Ther.
Physikalisch-Diaetetische Therapie *(West Germany)*
Phys. Earth Planet. Interiors
*Physics of the Earth and Planetary Interiors *(Netherlands)*
Pipes Pipelines Int.
Pipes and Pipelines International (formerly International Pipes and Pipelines) *(England)*
Piping Eng.
Piping Engineering, The
see *Haikan Gijutsu*
Plant Breed. Abstr.
*Plant Breeding Abstracts *(England)*
Plant Cell Physiol. (Kyoto)
Plant and Cell Physiology (Kyoto) *(Japan)*
Plastics (London)
*Plastics (London) *(England)*
Poluprov. Prib. Ikh Primen., Sb. Statei
Poluprovodnikovye Pribory i Ikh Primenenie, Sbornik Statei *(U.S.S.R.)*
Pop. Sci. (Peking)
Popular Science (Peking)
see *K'o Hsueh Ta Chung*
Poznan. Tow. Przyj. Nauk, Wydz. Lek., Pr. Kom. Farm.
Poznanskie Towarzystwo Przyjaciol Nauk, Wydzial Lekarski, Prace Komisji Farmaceutycznej *(Poland)*
Praxis (Bern)
Praxis (Bern) *(Switzerland)*
Probl. Fiziol. Opt.
Problemy Fiziologicheskoi Optiki *(U.S.S.R.)*
Proc. Amer. Soc. Hort. Sci.
Proceedings of the American Society for Horticultural Science *(U. S.)*
Proc. Astron. Soc. Aust.
Proceedings of the Astronomical Society of Australia *(Australia)*
Proc. Crop Sci. Soc. Jap.
Proceedings of the Crop Science Society of Japan
see *Nippon Sakumotsu Gakkai Kiji*
Prochnost Din. Aviats. Dvigatelei
Prochnost i Dinamika Aviatsionnykh Dvigatelei *(U.S.S.R.)*
Proc. Indian Acad. Sci., Sect. B
Proceedings of the Indian Academy of Sciences, Section B *(India)*
Proc. La. Acad. Sci.
*Proceedings of the Louisiana Academy of Sciences, The *(U. S.)*
Proc. Nat. Acad. Sci., India, Sect. A
Proceedings of the National Academy of Sciences, India, Section A *(India)*
Proc. Phys. Soc. (London)
Proceedings of the Physical Society (London) changed to Journal of Physics, A, B, and C *(England)*
Proc. Soc. Water Treat. Exam.
Proceedings of the Society for Water Treatment and Examination *(England)*
Proc. (Tr.) P. N. Lebedev Phys. Inst. (USSR) (Engl. Transl.)
*Proceedings (Trudy) of the P. N. Lebedev Physics Institute (USSR) (English Translation of Trudy Fizicheskogo Instituta imeni P. N. Lebedeva, Akademiya Nauk SSSR) *(U. S.)*
Prod. Eng.
Product Engineering *(U. S.)*
Prod. Pharm.
Produits Pharmaceutiques *(France)*
Progr. Ind. Microbiol.
Progress in Industrial Microbiology *(U. S.–England)*
Progr. Nucl. Tech. Instrum.
Progress in Nuclear Techniques and Instrumentation *(Netherlands)*
Progr. Solid State Chem.
Progress in Solid State Chemistry *(England)*
Progr. Stiintei
Progresele Stiintei *(Romania)*
Prot. Civ. Secur. Ind.
Protection Civile et Securite Industrielle *(France)*
Protein, Nucl. Acid, Enzyme
Protein, Nucleic Acid, Enzyme
see *Tanpakushitsu Kakusan Koso*
PTB Mitt.
*PTB Mitteilungen. Amts- und Mitteilungsblatt der Physikalisch-Technischen Bundesanstalt *(West Germany)*
Pubb. Centro Sper. Agr. Forest.
Pubblicazioni del Centro di Sperimentazione Agricola e Forestale *(Italy)*
Queensland Govt. Mining J.
Queensland Government Mining Journal *(Australia)*
Radiat. Res. Rev.
Radiation Research Reviews *(Netherlands)*
Radio (China)
Radio (China)
see *Wu Hsien Tien*
Radiobiol. Biol. Mol.
Radiobiologia si Biologia Moleculara *(Romania)*
Radioprotection
Radioprotection. Bulletin de la Societe Francaise de Radioprotection *(France)*
Rad. Poljopr. Fak. Univ. Sarajevu
Radovi Poljoprivrednog Fakulteta Univerziteta u Sarajevu *(Yugoslavia)*
Rakuno Kagaku No Kenkyu
Rakuno Kagaku No Kenkyu (Japanese Journal of Dairy Science) *(Japan)*
Razved. Okhr. Nedr
Razvedka i Okhrana Nedr *(U.S.S.R.)*
RCN (Reactor Cent. Ned.) Meded.
RCN (Reactor Centrum Nederland) Mededeling *(Netherlands)*
Reactor Fuel-Process. Technol.
*Reactor and Fuel-Processing Technology (A Quarterly Technical

Progress Review) (formerly Power Reactor Technology and Reactor Fuel Processing) *(U. S.)*

Rec. Trav. Bot. Neer.
Recueil des Travaux Botaniques Neerlandais *(Netherlands)*

Rend. Semin. Mat. Fis. Milano
Rendiconti del Seminario Matematico e Fisico di Milano *(Italy)*

Rep. Fac. Sci., Shizuoka Univ.
Reports of Faculty of Science, Shizuoka University *(Japan)*

Rep. Fire Res. Inst. Jap.
Report of Fire Research Inst. of Japan
see Shobo Kenkyusho Hokoku

Rep. Hokkaido Inst. Public Health
Report of the Hokkaido Inst. of Public Health
see Hokkaidoritsu Eisei Kenkyushoho

Rep. Ind. Res. Inst., Osaka Prefect.
Reports of Industrial Research Inst., Osaka Prefecture
see Osaka Furitsu Kogyo Shoreikan Hokoku

Rep. Nat. Res. Inst. Police Sci.
Reports of the National Research Inst. of Police Science
see Kagaku Keisatsu Kenkyusho Hokoku

Rep. Res. Inst. Ind. Safety
Reports of the Research Inst. of Industrial Safety
see Sangyo Anzen Kenkyusho Hokoku

Rep. Res. Inst. Sci. Ind., Kyushu Univ.
Reports of the Research Inst. of Science and Industry, Kyushu University
see Kyushu Daigaku Seisan Kagaku Kenkyusho Hokoku

Rep. Tokyo-to Lab. Med. Sci.
Report of Tokyo-to Lab. for Medical Sciences
see Tokyo Toritsu Eisei Kenkyusho Kenkyu Hokoku

Rep. Train. Inst. Eng. Teach., Kyoto Univ.
Report of the Training Inst. for Engineering Teachers, Kyoto University
see Kyoto Daigaku Kogyo Kyoin Yoseijo Kenkyu Hokoku

Res. Electrotech. Lab.
Researches of the Electrotechnical Laboratory
see Denki Shikenjo Kenkyu Hokoku

Res. Rep., Nagano Tech. Coll.
Research Reports, Nagano Technical College
see Nagano Kogyo Koto Senmon Gakko Kiyo

Rev. Acad. Cienc. Exactas, Fis.-Quim. Natur. Zaragoza
Revista de la Academia de Ciencias Exactas, Fisico-Quimicas y Naturales de Zaragoza *(Spain)*

Rev. Brasil. Quim. (Sao Paulo)
*Revista Brasileria de Quimica *(Brazil)*

Rev. Elec.
Revista Electricidade *(Portugal)*

Rev. Energ. Primaire
Revue Energie Primaire *(Belgium)*

Rev. Fr. Elec.
*Revue Francaise de l' Electricite *(France)*

Rev. Gen. Caout. Plast.
Revue Generale du Caoutchouc et des Plastiques *(France)*

Rev. Interamer. Radiol.
Revista Interamericana de Radiologia *(Peru)*

Rev. Laryngol., Otol., Rhinol., Suppl.
Revue de Laryngologie, Otologie, Rhinologie, Supplement *(France)*

Rev. Real Acad. Cienc. Exact., Fis. Nat. Madrid
Revista de la Real Academia de Ciencias Exactas, Fisicas y Naturales de Madrid *(Spain)*

Rev. Roum. Sci. Tech., Ser. Mecan. Appl.
Revue Roumaine des Sciences Techniques, Serie de Mecanique Appliquee *(Romania)*

Rev. Soudure (Brussels)
Revue de la Soudure (Brussels) *(Belgium)*

Rev. Zooteh. Med. Vet.
Revista de Zootehnic si Medicina Veterinara *(Romania)*

Rheol. Acta
Rheologica Acta *(West Germany)*

Roczn. Akad. Med. Bialymstoku
Roczniki Akademii Medycznej im. Juliana Marchlewskiego w Bialymstoku *(Poland)*

Roy. Observ. Bull.
Royal Observatory Bulletins *(England)*

Roy. Soc. Health J.
Royal Society of Health Journal *(England)*

Rudarsko-Met. Zbornik, Suppl.
Rudarsko-Metalurski Zbornik, Supplement *(Yugoslavia)*
For English Translation see Mining Met. Quart., Suppl.

Ruimtevaart
Ruimtevaart *(Netherlands)*

RUM, Rev. Universelle Mines
RUM, Revue Universelle des Mines, de la Metallurgie, de la Mecanique, des Travaux Publics, des Sciences et des Arts Appliques a l' Industrie (formerly Revue Universelle des Mines, de la Metallurgie, de la Mecanique, des Travaux Publics, des Sciences et des Arts Appliques a l'Industrie) *(Belgium)*

S. Afr. Mech. Eng.
South African Mechanical Engineer, The *(South Africa)*

Salt Res. Ind. (Bhavnagar, India)
Salt Research and Industry (Bhavnagar, India) *(India)*

Samoletostr. Tekh. Vozdush. Flota
Samoletostroenie i Tekhnika Vozdushnogo Flota *(U.S.S.R.)*

Sangyo Anzen Kenkyusho Hokoku
Sangyo Anzen Kenkyusho Hokoku (Reports of the Research Inst. of Industrial Safety) *(Japan)*

Sb. Geol. Ved, Uzita Geofyz.
Sbornik Geologickych Ved, Uzita Geofyzika *(Czechoslovakia)*

Sb. Ved. Pr. Lek. Fak. Karlovy Univ. Hradci Kralove, Suppl.
Sbornik Vedeckych Praci Lekarske Fakulty Karlovy University v Hradci Kralove, Supplementum *(Czechoslovakia)*

Scand. J. Clin. Lab. Invest., Suppl.
Scandinavian Journal of Clinical and Laboratory Investigation, Supplement *(Sweden)*

Schweiz. Arch. Tierheilk.
Schweizer Archiv fuer Tierheilkunde *(Switzerland)*

Schweiz. Muenzbl.
Schweizer Muenzblaetter *(Switzerland)*

Sciences (Paris)
Sciences et l'Enseignement des Sciences (Paris) *(France)*

Sci. Ind. Spatiales
Sciences et Industries Spatiales *(Switzerland)*

Sci. News (Wash., D. C.)
Science News (Washington, D. C.) *(U. S.)*

Sci. Proc. Roy. Dublin Soc., Ser. A
Scientific Proceedings of the Royal Dublin Society, The, Series A (supersedes The Scientific Proceedings of the Royal Dublin Society, New Series) *(Ireland)*

Sci. Rep., Coll. Gen. Educ., Osaka Univ.
Science Report, College of General Education, Osaka University *(Japan)*

Sci. Rep. Niigata Univ., Ser. B
Science Reports of Niigata University, Series B. Physics *(Japan)*

Scr. Met.
Scripta Metallurgica *(U. S.)*

Sekiyu Gakkaishi
Sekiyu Gakkaishi (Journal of the Japan Petroleum Institute) *(Japan)*

Seminars Hematol.
*Seminars in Hematology *(U. S.)*

Seminars Roentgenol.
Seminars in Roentgenology *(U. S.)*

Sen'i Gakkaishi
Sen'i Gakkaishi (Journal of the Society of Fiber Science and Technology, Japan) *(Japan)*

Ser. Haematol.
Series Haematologica (Supplements Scandinavia Journal of Haematology) *(Denmark)*

Sheet Metal Ind.
Sheet Metal Industries *(England)*

Shipping World Shipbuilder
Shipping World and Shipbuilder *(England)*

Shobo Kenkyusho Hokoku
Shobo Kenkyusho Hokoku (Report of Fire Research Inst. of Japan) *(Japan)*

Showa Densen Denran Rebyu
Showa Densen Denran Rebyu (Showa Wire and Cable Review) *(Japan)*

Showa Wire Cable Rev.
Showa Wire and Cable Review
see Showa Densen Denran Rebyu

Sichere Arb.
Sichere Arbeit *(Austria)*

Slaboproudy Obz.
Slaboproudy Obzor *(Czechoslovakia)*

S. Lumberman
Southern Lumberman *(U. S.)*

Soc. Petrol. Eng. J.
Society of Petroleum Engineers Journal, The *(U. S.)*

Soil Crop Sci. Soc. Fla., Proc.
Soil and Crop Science Society of Florida, Proceedings *(U. S.)*

Soobshch. Shemakhinskoi Astrofiz. Observ., Akad. Nauk Azerb. SSR
*Soobshcheniya Shemakhinskoi Astrofizicheskoi Observatorii, Akademiya Nauk Azerbaidzhanskoi SSR *(Azerbaidzhan S.S.R.)*

Sov. Antarct. Exped. Inform. Bull.
Soviet Antarctic Expedition Information Bulletin (English Translation of Informatsionnyi Byulleten Sovetskoi Antarkticheskoi Ekspeditsii) *(U. S.)*

Sov. Phys.-Semicond. (Engl. Transl.)
Soviet Physics-Semiconductors (English Translation of Fizika i Tekhnika Poluprovodnikov) *(U. S.)*
Space Biol. Med. (USSR) (Engl. Transl.)
Space Biology and Medicine (USSR) (English Translation of Kosmicheskaya Biologiya i Meditsina) *(U.S.)*
Space Life Sci.
Space Life Sciences *(Netherlands)*
Spectrum (Oxford)
Spectrum (Oxford) *(England)*
Spis. Bulg. Akad. Nauk.
Spisanie na Bulgarskata Akademiya na Naukite *(Bulgaria)*
SRW (Siemens-Reiniger-Werke) Nachr.
SRW (Siemens-Reiniger-Werke) Nachricht *(West Germany)*
Stainless (Tokyo)
Stainless, The (Tokyo)
see Sutenresu
Stain Technol.
Stain Technology *(U. S.)*
Steel Times
Steel Times *(England)*
Strahlenschutz Forsch. Prax.
Strahlenschutz in Forschung und Praxis *(West Germany)*
Strain
Strain *(England)*
Stud. Cercet. Endocrinol.
Studii si Cercetari de Endocrinologie *(Romania)*
Stud. Cercet. Energ. Electroteh.
Studii si Cercetari de Energetica si Electrotehnica *(Romania)*
Stud. Cosmic Ray
Studies of Cosmic Ray
see Uchusen Kenkyu
Sumitomo Kinzoku
Sumitomo Kinzoku (Sumitomo Metals) *(Japan)*
Sumitomo Metals
Sumitomo Metals
see Sumitomo Kinzoku
Sutenresu
Sutenresu (The Stainless) *(Japan)*
Svetsaren Engl.
Svetsaren in English *(Sweden)*
Sv. Lakartidn.
Svenska Lakartidningen *(Sweden)*
Sv. Naturvetensk.
Svensk Naturvetenskap *(Sweden)*
T'ai-wan I Hsueh Hui Tsa Chih
T'ai-wan I Hsueh Hui Tsa Chih (Journal of the Formosan Medical Association) *(China (Taiwan))*
Tanpakushitsu Kakusan Koso
Tanpakushitsu Kakusan Koso (Protein, Nucleic Acid, Enzyme) *(Japan)*
Tech. Dig. (Prague)
Technical Digest (Prague), Statni Nakladetelstvi Technicke Literatury *(Czechoslovakia)*
Tech. Mitt. AEG-Telefunken
*Technische Mitteilungen AEG-Telefunken (a continuation of AEG-Mitteilungen) *(West Germany)*
Technik (Berlin)
Technik (Berlin), Die *(East Germany)*
Technology (Sindri)
Technology (Sindri). Quarterly Bulletin of the Planning and Development Div., Fertilizer Corp. of India Ltd. *(India)*
Technol. Rep. Kyushu Univ.
Technology Reports of the Kyushu University
see Kyushu Daigaku Kogaku Shuho
Tech. Note Port Harbour Tech. Res. Inst., Min. Transp., Jap.
Technical Note of Port and Harbour Technical Research Inst., Ministry of Transporation, Japan
see Kowan Giken Shiryo
Tech. Petrole
Techniques du Petrole *(France)*
Tech. Rep. ISSP (Inst. Solid State Phys.), Ser. A
Technical Report of ISSP (Inst. for Solid State Physics), Series A *(Japan)*
Tech. Rep. Kumamoto Univ.
Technical Reports of the Kumamoto University
see Kumamoto Daigaku Kogakubu Kenkyu Hokoku
Tech. Rep. Nisshin Steel Co., Ltd.
Technical Report of Nisshin Steel Co., Ltd.
see Nisshin Seiko Giho
Tekhnol. Organ. Proizvod.
Tekhnologiya i Organizatsiya Proizvodstva *(Ukrainian S.S.R.)*
Tekst. Prom.
Tekstil'naya Promyshlennost *(U.S.S.R.)*
Teor. Prakt. Met., Sov. Nar. Khoz. Chelyabinsk. Ekon. Admin. Raiona, Nauch.-Issled. Inst. Met.
Teoriya i Praktika Metallurgii, Sovet Narodnogo Khozyaistva Chelyabinskogo Ekonomicheskogo Administrativnogo Raiona, Nauchno-Issledovatel'skii Institut Metallurgii *(U.S.S.R.)*
Terapia (Milan)
Terapia (Milan) *(Italy)*
Terapia (Turin)
Terapia (Turin) *(Italy)*
Thin Solid Films
Thin Solid Films *(Netherlands)*
Thoraxchir. Vask. Chir.
Thoraxchirurgie und Vaskulaere Chirurgie (formerly Thoraxchirurgie) *(West Germany)*
Tien Shih Chieh
Tien Shih Chieh (Electrical World) *(China)*
Tijdschr. Primaire Energ.
Tijdschrift Primaire Energie
see Rev. Energ. Primaire
Tohoku Daigaku Senko Seiren Kenkyusho Iho
Tohoku Daigaku Senko Seiren Kenkyusho Iho (Bulletin of the Research Inst. of Mineral Dressing and Metallurgy, Tohoku University) *(Japan)*
Tokyo Astron. Bull., Ser. II
Tokyo Astronomical Bulletin, Series II *(Japan)*
Tokyo Daigaku Jishin Kenkyusho Iho
Tokyo Daigaku Jishin Kenkyusho Iho (Bulletin of the Earthquake Research Inst., University of Tokyo) *(Japan)*
Tokyo Daigaku Uchu Koku Kenkyusho Hokoku
Tokyo Daigaku Uchu Kenkyusho Hokoku (Bulletin of the Institute of Space and Aeronautical Science, University of Tokyo) *(Japan)*
Tokyo Joshi Ika Daigaku Zasshi
Tokyo Joshi Ika Daigaku Zasshi (Journal of Tokyo Women's Medical College) *(Japan)*
Tokyo Toritsu Eisei Kenkyusho Kenkyu Hokoku
Tokyo Toritsu Eisei Kenkyusho Kenkyu Hokoku (Report of Tokyo-to Lab. for Medical Sciences) *(Japan)*
Tonind.-Ztg. Keram. Rundsch.
Tonindustrie-Zeitung und Keramische Rundschau *(West Germany)*
Trans. Amer. Ophthalmol. Soc.
Transactions of the American Ophthalmological Society *(Canada)*
Trans. Indian Ceram. Soc.
Tranactions of the Indian Ceramic Society *(India)*
Trans. Ing.
*Transactions. Ingenioeren *(Denmark)*
Trans. Inst. Metal Finish.
Transactions of the Institute of Metal Finishing *(England)*
Transp. Stroit.
Transportnoe Stroitel'stvo *(U.S.S.R.)*
Trans. Soc. Instrum. Contr. Eng.
Transactions of the Society of Instrument and Control Engineers *(Japan)*
Trans. Soc. Pathol. Jap.
Transactiones Societatis Pathologicae Japonicae
see Nippon Byori Gakkai Kaishi
Travaux
Travaux *(France)*
Tr. Gos. Gidrol. Inst.
Trudy Gosudarstvennogo Gidrologicheskogo Instituta *(U.S.S.R.)*
Tr. Gos. Issled. Elektrokeram. Inst.
Trudy Gosudarstvennogo Issledovatel'skogo Elektrokeramicheskogo Instituta *(U.S.S.R.)*
Tr., Gos. Nauch.-Issled. Proekt. Inst. Splavov Obrab. Tsvet. Metal.
Trudy, Gosudarstvennyi Nauchno-Issledovatel'skii i Proektnyi Institut Splavov i Obrabotki Tsvetnykh Metallov *(U.S.S.R.)*
Tr. Inst. Biol., Akad. Nauk SSSR, Ural. Filial
Trudy Instituta Biologii, Akademiya Nauk SSSR, Ural'skii Filial *(U.S.S.R.)*
Tr. Inst. Met. Obogashch., Akad. Nauk Kaz. SSR
Trudy Instituta Metallurgii i Obogashcheniya, Akademiya Nauk Kazakhskoi SSR *(Kazakh S.S.R.)*
Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.
Trudy Kazakhskogo Nauchno-Issledovatel'skogo Instituta Onkologii i Radiologii *(Kazakh S.S.R.)*
Tr. Kom. Spektrosk., Akad. Nauk SSSR
Trudy Komissii po Spektroskopii, Akademiya Nauk SSSR *(U.S.S.R.)*
Tr. Leningrad. Tekhnol. Inst. Tsellyul.-Bum. Prom.
Trudy Leningradskogo Tekhnologicheskogo Instituta Tsellyulozno-Bumazhnoi Promyshlennosti *(U.S.S.R.)*
Tr., Mosk. Aviats. Tekhnol. Inst.
Trudy, Moskovskii Aviatsionnyi Tekhnologicheskii Institut *(U.S.S.R.)*

Tr. Mosk. Vet. Akad.
Trudy Moskovskoi Veterinarnoi Akademii *(U.S.S.R.)*

Tr. Sib. Tekhnol. Inst.
Trudy Sibirskogo Tekhnologicheskogo Instituta *(U.S.S.R.)*

Tr. Teor. Polya
Trudy po Teorii Polya *(U.S.S.R.)*

TRW Space Log
TRW Space Log *(U. S.)*

Tumor Res.
Tumor Research *(Japan)*

Tungsten News
Tungsten News *(U.S.)*

T Z Prakt. Metallbearb.
T Z fuer Praktische Metallbearbeitung *(West Germany)*

Uchusen Kenkyu
Uchusen Kenkyu (Studies of Cosmic Ray) *(Japan)*

Upr. Yadern. Energ. Ustanovkami, Sb. Statei
*Upravlenie Yadernymi Energeticheskimi Ustanovkami, Moskovskii Inzhenerno-Fizicheskii Institut, Sbornik Statei *(U.S.S.R.)*

U. S. Nav. Inst., Proc.
United States Naval Institute, Proceedings *(U. S.)*

Vector (Baltimore)
Vector (Baltimore) *(U. S.)*

Ved. Pr. Vyzk. Ustavu Vet. Lek. Brne
Vedecke Prace Vyzkumneho Ustavu Veterinarniho Lekarstvi v Brne (superseded by Documenta Veterinaria) *(Czechoslovakia)*

Vestn. Cesk. Spolecnosti Zool.
Vestnik Ceskoslovenske Spolecnosti Zoologicke *(Czechoslovakia)*

Vestn. Leningrad. Univ., Ser. Biol.
Vestnik Leningradskogo Universiteta, Seriya Biologii *(U.S.S.R.)*

Vestn. Mosk. Univ., Ser. I, Mat., Mekh.
Vestnik Moskovskogo Universiteta, Seriya I, Matematika, Mekhanika *(U.S.S.R.)*

Vestn. Mosk. Univ., Ser. IV. Geol.
Vestnik Moskovskogo Universiteta, Seriya IV. Geologiya *(U.S.S.R.)*

Vestn. Ustred. Ustavu Geol.
Vestnik Ustredniho Ustavu Geologickeho *(Czechoslovakia)*

Vodosnabzh. Sanit. Tekh.
Vodosnabzhenie i Sanitarnaya Tekhnika *(U.S.S.R.)*

Vojnosanit. Pregl.
Vojnosanitetski Pregled *(Yugoslavia)*

Volt, Elec. Trade Mon.
Volt, Electrical Trade Monthly *(Japan)*

Vop. Eksp. Klin. Radiol., Khar'kov. Inst. Med. Radiol.
Voprosy Eksperimental'noi i Klinicheskoi Radiologii, Khar'kovskii Institut Meditsinskoi Radiologii *(Ukrainian S.S.R.)*

Water Res.
Water Research (supersedes in part Air and Water Pollution) *(England)*

Water Waste Treat.
Water and Waste Treatment *(England)*

Weld. Eng.
Welding Engineer *(U. S.)*

Weld. Res. Counc. Bull.
Welding Research Council Bulletin *(U. S.)*

Wiad. Hutn.
Wiadomosci Hutnicze *(Poland)*

Wien. Z. Inn. Med. Grenzgeb.
Wiener Zeitschrift fuer Innere Medizin und ihre Grenzgebiete *(Austria)*

Wiss. Z. Ernst-Moritz-Arndt-Univ. Greifswald, Math.-Naturwiss. Reihe
Wissenschaftliche Zeitschrfit der Ernst-Moritz-Arndt-Universitaet Greifswald, Mathematisch-Naturwissenschaftliche Reihe *(East Germany)*

Wiss. Z. Humboldt-Univ. Berlin, Math.-Naturwiss. Reihe
Wissenschaftliche Zeitschrift der Humboldt-Universitaet zu Berlin, Mathematisch-Naturwissenschaftliche Reihe *(East Germany)*

Wonjaryogwon. Yon'gu Nonmun Chip
Wonjaryogwon. Yon'gu Nonmun Chip
see J. Nucl. Sci. (Seoul)

World Mining
World Mining *(U. S.)*

Wu Hsien Tien
Wu Hsien Tien (Radio) *(China)*

Yadern. Priborostr., Nauch.-Tekh. Sb.
Yadernoe Priborostroenie, Nauchno-Tekhnicheskii Sbornik *(U.S.S.R.)*

Yakugaku Kenkyu
Yakugaku Kenkyu (Japanese Journal of Pharmacy and Chemistry) *(Japan)*

Yuan Tzu Neng
Yuan Tzu Neng (Atomic Energy) *(China)*

Zap. Leningrad. Gorn. Inst.
Zapiski Leningradskogo Gornogo Instituta *(U.S.S.R.)*

Zem. Beton
Zement und Beton *(Austria)*

Zemlya Vselennaya
Zemlya i Vselennaya *(U.S.S.R.)*

Zentralbl. Neurochir.
Zentralblatt fuer Neurochirurgie *(East Germany)*

Z. Ernaehrungswiss., Suppl.
Zeitschrift fuer Ernaehrungswissenschaft, Supplementa *(West Germany)*

Zh. Org. Khim.
*Zhurnal Organicheskoi Khimii *(U.S.S.R.)*

Z. Immunitaetsforsch., Allergie Klin. Immunol.
Zeitschrift fuer Immunitaetsforschung, Allergie und Klinische Immunologie *(West Germany)*

Z. Kinderheilk.
Zeitschrift fuer Kinderheilkunde *(West Germany)*

Z. Math. Phys.
Zeitschrift fuer Mathematik und Physik *(East Germany)*

Z. Mikrosk.-Anat. Forsch.
Zeitschrift fuer Mikroskopisch-Anatomische Forschung (Abt. 2 of Jahrbuch fuer Morphologie und Mikroskopische Anatomie) *(East Germany)*

Zoologica (Seoul)
Zoologica (Seoul) *(South Korea)*

Zool. Zh.
Zoologicheskii Zhurnal *(U.S.S.R.)*

Z. Phys. Chem. B
Zeitschrift fuer Physikalische Chemie. Abt. B *(Germany)*

Z. Psychol. Physiol. Sinnesorg.
Zeitschrift fuer Psychologie und Physiologie der Sinnesorgane *(East Germany)*

Z. Sinnephysiol.
Zeitschrift fuer Sinnephysiologie *(East Germany)*

Z. Tech. Ueberwach.
Zeitschrift Technische Ueberwachung *(Austria)*

Z. Urol. Nephrol.
Zeitschrift fuer Urologie und Nephrologie *(East Germany)*

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